INSTRUCTION MANUAL

Serial Number _____

TYPE R250 AUXILIARY PROGRAM UNIT

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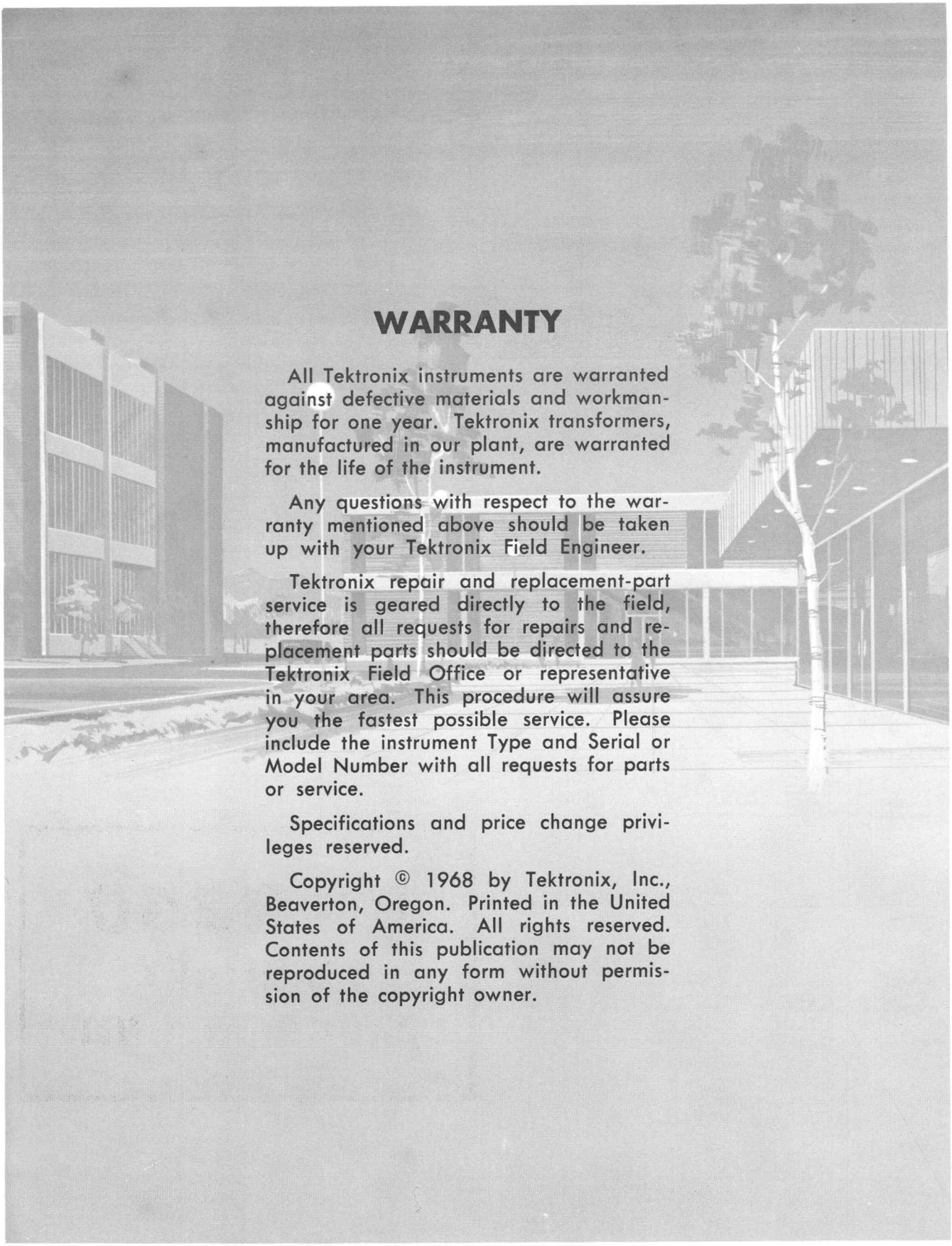
070-0748-00 1268



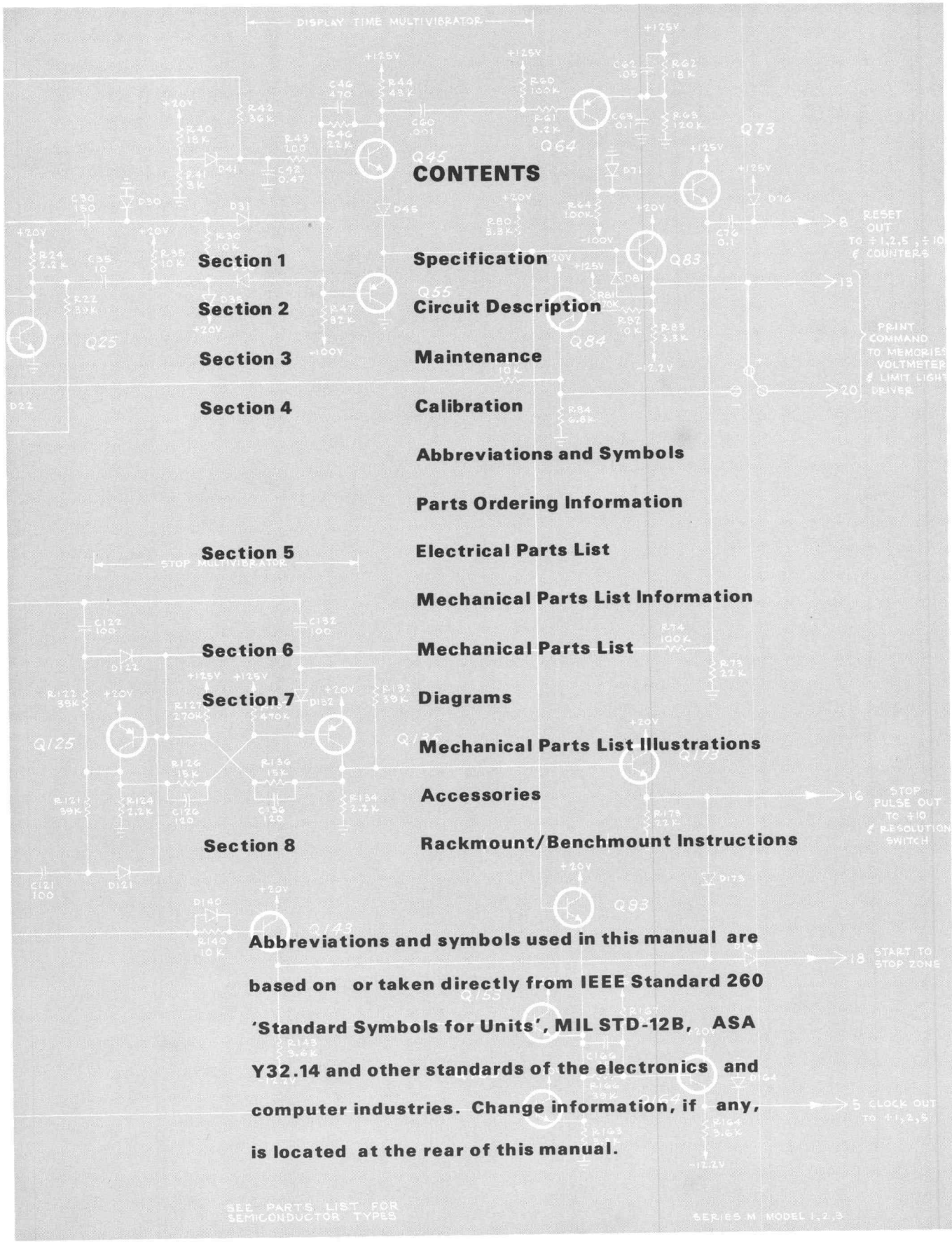
WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.



CONTENTS

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 'Standard Symbols for Units', MIL STD-12B, ASA Y32.14 and other standards of the electronics and computer industries. Change information, if any, is located at the rear of this manual.

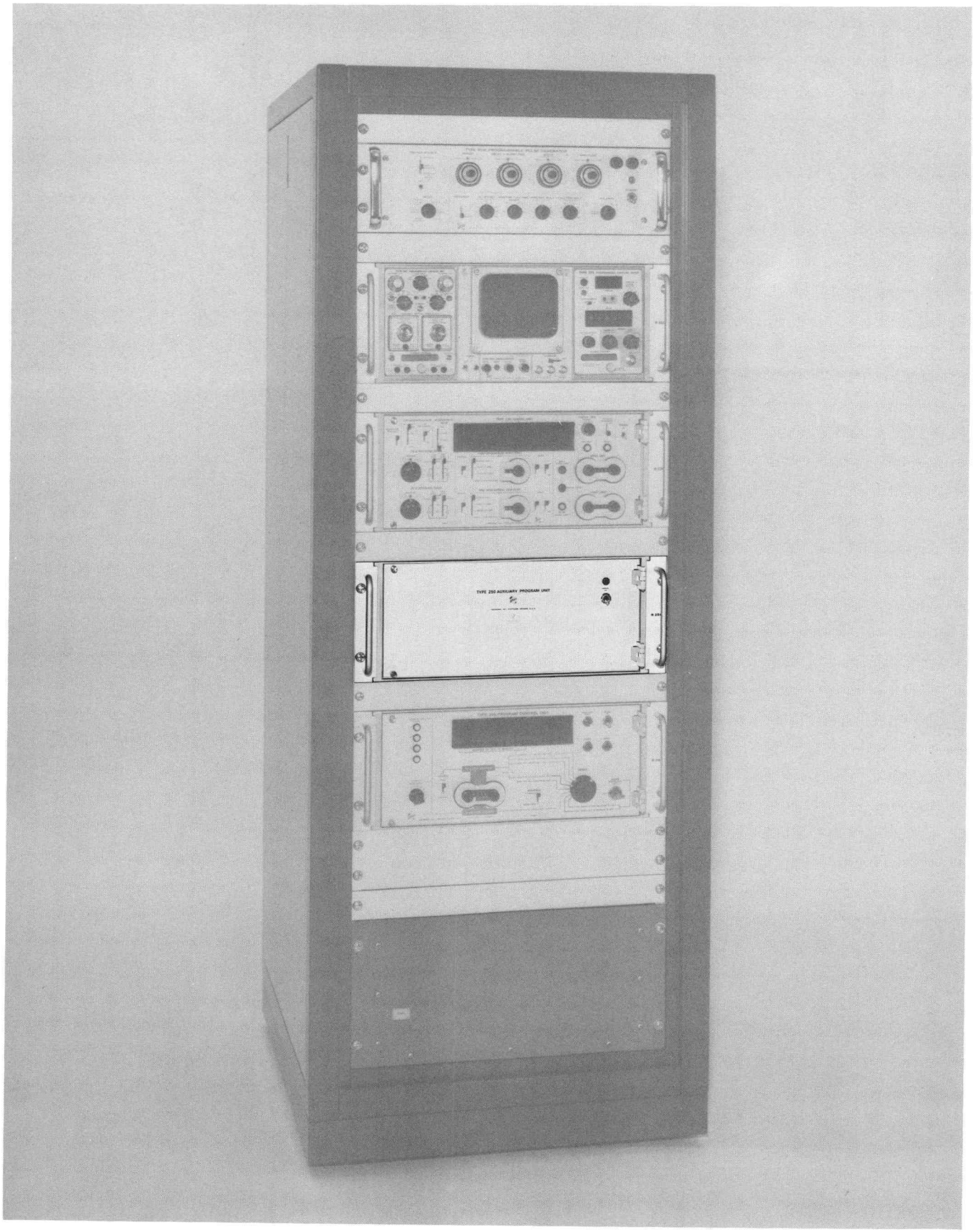


Fig. 1-1. The Tektronix Type R250 Auxiliary Program Unit.

SECTION 1
SPECIFICATION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The Type R250 Auxiliary Program Unit is a shift register designed to be used as a system component, with the Type 240 Program Control Unit supplying data and command signals. Each Type R250 controls up to 192 parallel program lines which may be used for programming power supplies, pulse generators, fixtures or other devices in the system. Either one or two Type R250's can be used with a single Type 240 to provide up to 384 or 576 program lines, respectively, from the combination of instruments.

Programming is provided by means of 12 plug-in program assembly cards, to be purchased and assembled by the customer to match the needs of the system. Each assembly is to be constructed from one shift register card and two program boards, available as optional accessories with the Type R250. Three types of program boards are available: standard (saturated transistor), resistance, and conductance. Any combination of two program boards may be used with each shift register card. Each series of eight program lines from the plug-in card jacks is controlled by a single program board (standard, resistance or conductance), but connections to the program lines can be cross-coupled on the program assemblies to provide nearly any desired input/output arrangement at the rear-panel program connectors.

A standard program board provides 8 parallel buffered output program lines, using negative programing logic. The true output level is from zero to +2 volts, provided by a saturated NPN transistor in series with a diode. The false output level may be as high as +20 V, depending on pull-up connections. Pull-up to +3.6 V or +10 V may be wired on the circuit board or external pull-up may be used. No pull-up resistors are provided on the board as pre-wired.

Each resistance program board provides two separate decades of series resistance for analog resistance programming. Each conductance program board provides two separate decades of parallel resistance for analog conductance programming. In either case, the resistors must be added to the program boards to meet the requirements of the device to be programmed. When a resistance or conductance program board is wired to a shift register card, digital-to-analog conversion is performed on the circuit board assembly to select the desired increments of resistance.

Two programmable Tektronix instruments are presently available for use with the Type R250. These are the Type R116 Mod 703L pulse generator and the Type R293 Mod 703M pulse generator and power supply. These instruments are supplied with interconnecting cables and preassembled program cards which plug into the Type R250.

Electrical Characteristics

The input/output characteristics of the Type R250 depend on the program board combinations to be used in the instrument. The only instrument specifications, therefore, are those of power supply outputs, input/output connections of the instrument, and input/output characteristics of the separate component program boards.

Characteristics given in Tables 1-1 and 1-2 apply for instruments with program assemblies installed, operated at an ambient temperature of from 0°C to +60°C after an initial warm-up period of 5 minutes, when previously calibrated at an ambient temperature of +25°C ±5°C.

TABLE 1-1

TYPE R250 ELECTRICAL CHARACTERISTICS

Input/Output Lines

J112 Type 240/250 Interconnect			Performance	
	Inputs	Outputs	True	False
Pins 1 through 10	Twisted pair grounds for signal wires 19 through 28			
Pins 11 through 18	Not internally connected			
Pin 19	DATA $\overline{8}$		+0.4 V or less at 0 mA	At least +1.7 V at 2 mA
Pin 20	DATA $\overline{4}$			
Pin 21	DATA $\overline{2}$			
Pin 22	DATA $\overline{1}$			
Pin 23	SHIFT		+0.5 V to +1.2 V	+2.2 V to +3.6 V
			Negative-going pulse: Width — At least 330 ns Period — At least 1.66 µs Risetime — 70 ns or less Falltime — 70 ns or less	
Pin 24	EXTERNAL INHIBIT		+0.4 V or less at 0 mA	At least +1.7 V at 4.7 mA
Pin 25		DATA $\overline{1}$	+0.4 V or less at 0 mA	At least +1.7 V at 4.7 mA
Pin 26		DATA $\overline{2}$		
Pin 27		DATA $\overline{4}$		
Pin 28		DATA $\overline{8}$		
Pins 29 through 36	Not internally connected			

J206 Power Output			Performance		
	Inputs	Outputs	Current Available	120 Hz Ripple	Shift Noise
Pins 1 through 9	Not internally connected				
Pins 10 through 16	Connected to J13, Pins M, N, P, R, S, T and U				

Pins 17 and 18	Not internally connected				
Pins 19 through 28	Ground				
Pins 29 and 30		+10 volts	Up to 500 mA	10 mV or less peak to peak	150 mV or less peak to peak
Pins 31 and 32		-10 volts	Up to 800 mA	10 mV or less peak to peak	150 mV or less peak to peak
Pins 33 and 34		+20 volts	Up to 300 mA	15 mV or less peak to peak	150 mV or less peak to peak
Pins 35 and 36		+3.6 volts	Up to 1.5 A	10 mV or less peak to peak	220 mV or less peak to peak
J231, J232, J233, J234, J235, J236, J237	Auxiliary Equipment Connectors		Performance		
			Input/Output characteristics of these rear-panel connectors are determined by the characteristics and wiring connections of the component boards assembled as program assemblies and installed in jacks J1 through J12. See Table 1-2 for the input/output characteristics of the individual assemblies and see the wiring tables in Section 3 for the internal wiring connections from the program boards to these connectors.		

Power Source

Characteristic	Performance			
Line Frequency	50 Hz or 60 Hz			
Voltage and Power	Line Voltage Range (AC, RMS)			Maximum Power Consumption
		115 V Nominal	230 V Nominal	
	Low	90 V to 110 V	180 V to 220 V	170 W
	Medium	104 V to 126 V	208 V to 252 V	195 W
	High	112 V to 136 V	224 V to 272 V	215 W

TABLE 1-2

PROGRAM ASSEMBLY ELECTRICAL CHARACTERISTICS

Program Board Internal Characteristics

Standard Board		Resistance Board		Conductance Board	
Characteristic	Performance	Characteristic	Performance	Characteristic	Performance
Output Program Levels True False	0 V to +2 V Nominal +6 V to +12 V; up to +20 V.	Maximum Input/output Current	300 mA	Maximum Input/output Current	300 mA
		Maximum Open-circuit Voltage	50 V	Maximum Open-circuit Voltage	50 V
		Reed Pull-in Time	550 µs ±20%	Reed Pull-in Time	450 µs ±10%
Output Current	25 mA maximum available on each line (total of 200 mA maximum for 8 lines)	Reed Drop-out Time	1.2 ms ±20%	Reed Drop-out Time	325 µs ±15%
		Reed Contact Resistance	0.1 Ω or less	Reed Contact Resistance	0.1 Ω or less
		NOTE Use only a resistive DC load. Any capacitive or inductive load may damage the reed contacts.		NOTE Use only a resistive DC load. Any capacitive or inductive load may damage the reed contacts.	

Program Assembly Input/Output Characteristics (When wired as in Table 1-3)

Shift Register Connector Term.	Shift Register Input/Output		Program Board Input/Output					
			Standard		Resistance		Conductance	
	Input Req.	Output Char.	Input Req.	Output Char.	Input Req.	Output Char.	Input Req.	Output Char.
Pin 1	+3.6 V (to upper board)		+3.6 V (if used)		+3.6 V		(Not used)	
Pin 2	DATA $\overline{8}$ in True: +0.4 V or less at 0 mA False: At least +1.7 V at 2 mA							
Pin 3		DATA $\overline{8}$ out True: +0.4 V or less at 0 mA False: At least +1.7 V at 4.7 mA						
Pins 4 and 5	No internal connection							

Pin 6	DATA $\overline{4}$ in True: +0.4 V or less at 0 mA False: At least +1.7 V at 2 mA				
Pin 7		DATA $\overline{4}$ out True: +0.4 V or less at 0 mA False: At least +1.7 V at 4.7 mA			
Pin 8	ENABLE (to upper board)		ENABLE[1] True: 0 V to +0.05 V at 210 mA or less; 0 V to +0.45 V at 16 mA or less False: +2.5 V to +5 V at 1 μA or less	ENABLE[1] True: 0 V to +0.05 V at 15 mA or less False: +2.5 V to +5 V at 1 μA or less	ENABLE[1] True: 0 V to +0.05 V at 210 mA or less False: +2.5 V to +5 V at 1 μA or less
Pin 9	BUS 1 (to upper board)				
Pin 10	BUS 2 (to upper board)				
Pin 11	BUS 3 (to upper board)				
Pin 12	BUS 4 (to upper board)				
Pin 13	EXT INHIBIT (to upper board)		EXT INHIBIT[1] (from J13-23) True: 0 V to +0.5 V at 1 μA or less False: 1.9 V to +3 V and at least 4 mA	EXT INHIBIT[1] (from J13-23) True: 0 V to +0.5 V at 1 μA or less False: +1.9 V to +3 V and at least 1 mA	EXT INHIBIT[1] (from J13-23) True: 0 V to +0.5 V at 1 μA or less False: +1.9 V to +3 V and at least 8 mA
Pin 14	GND (to shift register and upper board)		GND	GND	GND
Pin 15	+3.6 V (to lower board)		+3.6 V (if used)	+3.6 V	(Not used)
Pin 16	DATA $\overline{2}$ in True: +0.4 V or less at 0 mA False: At least +1.7 V at 2 mA				

[1]Specifications with P13 Regulator card Model 2-up.

Pin 17		DATA $\overline{2}$ out True: +0.4 V or less at 0 mA False: At least +1.7 V at 4.7 mA			
Pin 18	No internal connection				
Pin 19	$\overline{\text{SHIFT}}$ (negative-going pulse) True: +0.5 V to +1.2 V Width: At least 330 ns Period: At least 1.66 µs Rise-time: 70 ns or less Fall-time: 70 ns or less False: +2.2 V to +3.6 V				
Pin 20	DATA $\overline{1}$ in True: +0.4 V or less at 0 mA False: At least +1.7 V at 2 mA				
Pin 21		DATA $\overline{1}$ out True: +0.4 V or less at 0 mA False: At least +1.7 V at 4.7 mA			
Pin 22	ENABLE (to lower board)		ENABLE[1] True: 0 V to +0.05 V at 210 mA or less; 0 V to +0.45 V at 16 mA or less False: +2.5 V to +5 V at 1 µA or less	ENABLE[1] True: 0 V to +0.05 V at 15 mA or less False: +2.5 V to +5 V at 1 µA or less	ENABLE[1] True: 0 V to +0.05 V at 210 mA or less False: +2.5 V to +5 V at 1 µA or less
Pin 23	BUS 5 (to lower board)				

Pin 24	BUS 6 (to lower board)											
Pin 25	BUS 7 (to lower board)											
Pin 26	EXT INHIBIT (to lower board)		EXT INHIBIT[1] (from J13-27) True: 0 V to +0.5 V at 1 µA or less False: +1.9 V to +3 V and at least 4 mA			EXT INHIBIT[1] (from J13-27) True: 0 V to +0.5 V at 1 µA or less False: +1.9 V to +3 V and at least 1 mA			EXT INHIBIT[1] (from J13-27) True: 0 V to +0.5 V at 1 µA or less False: +1.9 V to +3 V and at least 8 mA		
Pin 27	BUS 13											
Pin 28	-10 V (to upper and lower boards)		-10 V (if used)			(Not used)			(Not used)			
Pin A	+10 V (to upper and lower boards)		+10 V (if used)			+10 V			+10 V			
Pins B thru E	Internal connections not used											
Pin F		(from upper board)		OUT 18 True: 0 V to +2 V False: +6 V to +12 V			No internal connection			No internal connection		
Pin H		(from upper board)		OUT 14 True: 0 V to +2 V False: +6 V to +12 V			No internal connection			No internal connection		
Pin J		(from upper board)		OUT 12 True: 0 V to +2 V False: +6 V to +12 V			No internal connection			No internal connection		
Pin K		(from upper board)		OUT 11 True: 0 V to +2 V False: +6 V to +12 V			No internal connection			No internal connection		
Pin L		(from upper board)		OUT 28 True: 0 V to +2 V False: +6 V to +12 V			300 mA maximum	Decade 2 Out/In		300 mA maximum	Decade 2 Out/In	
Pin M		(from upper board)		OUT 24 True: 0 V to +2 V False: +6 V to +12 V			300 mA maximum	Decade 2 In/Out		300 mA maximum	Decade 2 In/Out	

Pin N		(from upper board)		OUT 22 True: 0 V to +2 V False: +6 V to +12 V		300 mA maximum	Decade 1 Out/In		300 mA maximum	Decade 1 Out/In
Pin P		(from upper board)		OUT 21 True: 0 V to +2 V False: +6 V to +12 V		300 mA maximum	Decade 1 In/Out		300 mA maximum	Decade 1 In/Out
Pin R	GND (connected to Pin 14)									
Pin S	+3.6 V (to lower board) (connected to Pin 15)									
Pin T		(from lower board)		OUT 18 True: 0 V to +2 V False: +6 V to +12 V		No internal connection			No internal connection	
Pin U		(from lower board)		OUT 14 True: 0 V to +2 V False: +6 V to +12 V		No internal connection			No internal connection	
Pin V		(from lower board)		OUT 12 True: 0 V to +2 V False: +6 V to +12 V		No internal connection			No internal connection	
Pin W		(from lower board)		OUT 11 True: 0 V to +2 V False: +6 V to +12 V		No internal connection			No internal connection	
Pin X		(from lower board)		OUT 28 True: 0 V to +2 V False: +6 V to +12 V		300 mA maximum	Decade 2 Out/In		300 mA maximum	Decade 2 Out/In
Pin Y		(from lower board)		OUT 24 True: 0 V to +2 V False: +6 V to +12 V		300 mA maximum	Decade 2 In/Out		300 mA maximum	Decade 2 In/Out

Pin Z		(from lower board)		OUT 22 True: 0 V to +2 V False: +6 V to +12 V		300 mA maximum	Decade 1 Out/In		300 mA maximum	Decade 1 Out/In
Pin AA		(from lower board)		OUT 21 True: 0 V to +2 V False: +6 V to +12 V			Decade 1 In/Out			Decade 1 In/Out
Pins BB thru EE	Internal connections not used									
Pin FF	GND (to lower board)		GND		GND			GND		

TABLE 1-3

NORMAL INPUT/OUTPUT CONNECTIONS
OF PROGRAM ASSEMBLIES
(For use with Table 1-2)

Standard Input Connections

Input Terminal to Shift Register Card (P1-P12)	(From) Shift Register Terminal		(To) Program Board Terminal	Input to Program Board Input Connecting Link[2] (Soldered between Shift Register terminal and Program Board terminal) Standard Board	Resistance Board	Conductance Board
	Upper CHARACTER 18	Upper Program Board	CHARACTER 18	R68(U) 750 Ω	R368(U) 160 Ω	R268(U) 300 Ω
	Upper CHARACTER 14		CHARACTER 14	R64(U) 750 Ω	R364(U) 160 Ω	R264(U) 300 Ω
	Upper CHARACTER 12		CHARACTER 12	R62(U) 750 Ω	R362(U) 160 Ω	R262(U) 300 Ω
	Upper CHARACTER 11		CHARACTER 11	R61(U) 750 Ω	R361(U) 160 Ω	R261(U) 300 Ω
	Upper CHARACTER 28		CHARACTER 28	R78(U) 750 Ω	R378(U) 160 Ω	R278(U) 300 Ω
	Upper CHARACTER 24		CHARACTER 24	R74(U) 750 Ω	R374(U) 160 Ω	R274(U) 300 Ω
	Upper CHARACTER 22		CHARACTER 22	R72(U) 750 Ω	R372(U) 160 Ω	R272(U) 300 Ω
	Upper CHARACTER 21		CHARACTER 21	R71(U) 750 Ω	R371(U) 160 Ω	R271(U) 300 Ω

[2]Resistance values shown for connecting links are those shipped with the program board kits, and will operate under any load conditions. Some power economy can be achieved in many cases by increasing these resistances to suit the application. All input resistors are fixed, composition, ¼-watt, ±5%.

Specification—Type R250

Pin 13	EXT INH	Upper Program Board	EXT INH		R27(U) 430 Ω	R387(U) 1 kΩ	R287(U) 240 Ω
Pin 8	ENABLE		ENABLE		Bus**	Bus**	Bus**
Pin 1	(+3.6 V)		+3.6 V	Not both	Bus**(if used)	Bus**	Bus**
Pin A	*+10 V)		+10 V		Bus**(if used)	Bus**	Bus**
Pin 28	(-10 V)		-10 V		- -	- -	- -
Pins 14 and R	GND		GND		Bus**	Bus**	Bus**
	Lower CHARACTER 18	Lower Program Board	CHARACTER 18		R68(L) 750 Ω	R368(L) 160 Ω	R268(L) 300 Ω
	Lower CHARACTER 14		CHARACTER 14		R64(L) 750 Ω	R364(L) 160 Ω	R264(L) 300 Ω
	Lower CHARACTER 12		CHARACTER 12		R62(L) 750 Ω	R362(L) 160 Ω	R262(L) 300 Ω
	Lower CHARACTER 11		CHARACTER 11		R61(L) 750 Ω	R361(L) 160 Ω	R261(L) 300 Ω
	Lower CHARACTER 28		CHARACTER 28		R78(L) 750 Ω	R378(L) 160 Ω	R278(L) 300 Ω
	Lower CHARACTER 24		CHARACTER 24		R74(L) 750 Ω	R374(L) 160 Ω	R274(L) 300 Ω
	Lower CHARACTER 22		CHARACTER 22		R72(L) 750 Ω	R372(L) 160 Ω	R272(L) 300 Ω
	Lower CHARACTER 21		CHARACTER 21		R71(L) 750 Ω	R371(L) 160 Ω	R271(L) 300 Ω
Pin 26	EXT INH		EXT INH		R27(L) 130 Ω	R387(L) 1 kΩ	R287(L) 130 Ω
Pin 22	ENABLE		ENABLE		Bus**	Bus**	Bus**
Pins 15 and S	(+3.6 V)		+3.6 V	Not both	Bus**(if used)	Bus**	- -
Pin A	(+10 V)		+10 V		Bus**(if used)	Bus**	Bus**
Pin 28	(-10 V)		-10 V		- -	- -	- -
Pin FF	GND		GND		Bus**	Bus**	Bus**

- - No internal connection

**Insulated bus wire, usually called "Terminal Connector Link".

Standard Output Connections

	Normal (straight-across) Output Connection from Program Board (Terminal Connector Link soldered between Program Board output terminal and Shift Register terminal)				Output Terminal from Shift Register Card (P1-P12)
	(From) Program Board Terminal			(To) Shift Register Terminal	
	Standard Board	Resistance Board	Conductance Board		
Upper Board	Upper OUT 18	- -	- -	UPPER OUT 18	Pin F
	Upper OUT 14	- -	- -	UPPER OUT 14	Pin H
	Upper OUT 12	- -	- -	UPPER OUT 12	Pin J
	Upper OUT 11	- -	- -	UPPER OUT 11	Pin K
	Upper OUT 28	Upper OUT 1	Upper OUT 1	UPPER OUT 28	Pin L
	Upper OUT 24	Upper OUT 1	Upper OUT 1	UPPER OUT 24	Pin M
	Upper OUT 22	Upper OUT 2	Upper OUT 2	UPPER OUT 22	Pin N
	Upper OUT 21	Upper OUT 2	Upper OUT 2	UPPER OUT 21	Pin P
	- -	- -	- -	P28	Pin B
	- -	- -	- -	P24	Pin C
	- -	- -	- -	P22	Pin D
	- -	- -	- -	P21	Pin E

Lower Board	Lower OUT 18	- -	- -	LOWER OUT 18	Pin T
	Lower OUT 14	- -	- -	LOWER OUT 14	Pin U
	Lower OUT 12	- -	- -	LOWER OUT 12	Pin V
	Lower OUT 11	- -	- -	LOWER OUT 11	Pin W
	Lower OUT 28	Lower OUT 1	Lower OUT 1	LOWER OUT 28	Pin X
	Lower OUT 24	Lower OUT 1	Lower OUT 1	LOWER OUT 24	Pin Y
	Lower OUT 22	Lower OUT 2	Lower OUT 2	LOWER OUT 22	Pin Z
	Lower OUT 21	Lower OUT 2	Lower OUT 2	LOWER OUT 21	Pin AA
	- -	- -	- -	N18	Pin BB
	- -	- -	- -	N14	Pin CC
	- -	- -	- -	N12	Pin DD
	- -	- -	- -	N11	Pin EE

TABLE 1-4

ENVIRONMENTAL CHARACTERISTICS

Characteristic		Performance
Ambient Temperature		
	Operating	From 0°C to +60°C
	Non-operating	From -40°C to +65°C
Maximum Altitude		
	Operating	15,000 feet
	Non-operating	50,000 feet
Transportation (Package vibration and drop)		Qualified under National Safe Transit Committee Test Procedure 1A, Category I (18 inch drop)

TABLE 1-5

PHYSICAL CHARACTERISTICS

Characteristic		Description	
Dimensions		Type 240	Type R240
	Height	7 7/8 inches (20 cm)	7 inches (17.8 cm)
	Width	16 3/4 inches (42.6 cm)	19 inches (48.3 cm)
	Length (overall)	21 7/8 inches (55.6 cm)	22 5/8 inches (57.5 cm)
Finish			
	Front Panel	Anodized aluminum	
	Cabinet	Blue-vinyl painted aluminum	

NOTES

SECTION 2
CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The Type R250 is basically a shift register. It extends the capability of the Type 240 by adding 48 characters of additional temporary storage to the 48 character capacity of the Type 240. The instrument is dependent upon the Type 240 for shift pulses, character data and external inhibit signals. These signals are furnished to the Type R250 via J112 on the Type R250 rear panel. The Type 240 controls a measurement package while the Type R250 may be used to control other equipment by means of standard ground closure programming, resistance programming or conductance programming.

Accessories required with the Type R250 include the following:

a. Shift Register Card. Tektronix Part Number 020-0020-00. The instrument requires 12 shift register cards in order to operate.

b. Standard Program Board. Tektronix Part Number 010-0021-00.

c. Conductance Program Board. Tektronix Part Number 020-0022-00.

d. Resistance Program Board. Tektronix Part Number 020-0023-00.

If the Type R250 is used to its fullest extent, 24 of these boards are required. Any combination of these boards may be used, depending upon the requirements of the programmed equipment. These boards and the Shift Register Cards may be ordered through your local Tektronix Field Engineer.

POWER SUPPLY

General

The power supply circuit supplies the operating power for this instrument from four regulated supplies. Electronic regulation is used to provide stable low-ripple output voltages. Each regulated supply contains a short-protection circuit to prevent instrument damage if a supply is inadvertently shorted to ground. The power input stage includes the Voltage Selector Assembly. This assembly allows selection of the nominal operating voltage regulating range for the instrument. Fig. 2-1 shows the detailed block diagram of the power supply circuit. See also the Power Supply diagram at the rear of this manual.

Power Input

Power is applied to the primary of transformer T1101 through the 115-V line fuse F1101, power switch SW1101, thermal cutout TK1101, voltage selector switch SW1102 and range selector switch SW1103. Voltage selector switch SW1102 connects the split primaries of T1101 in parallel for 115-V nominal operation or in series for 230-V nominal operation. A second line fuse (F1102) is connected into the circuit when the voltage selector switch is set to the 230-V position. The current rating of F1102 is one-half that of F1101. Although F1101 remains in series with the primary, F1102 takes protection precedence over F1101.

The fan is connected across one half of the split primary winding so that it always has about 115 volts supplied to it. The range selector switch (SW1103) allows the instrument to regulate correctly on higher or lower than normal line voltages. Each half of the primary has taps above and below the 115-V (230-V) nominal point. As SW1103 is switched from low to high, the transformer turns ratio is decreased. This provides the correct voltage from the secondary of T1101 for increased primary voltage. Thermal cutout TK1101 provides thermal protection for this instrument. If the Type R250 internal temperature becomes too high, TK1101 opens to interrupt the applied voltage. When the temperature returns to normal, TK1101 automatically closes to reapply the power.

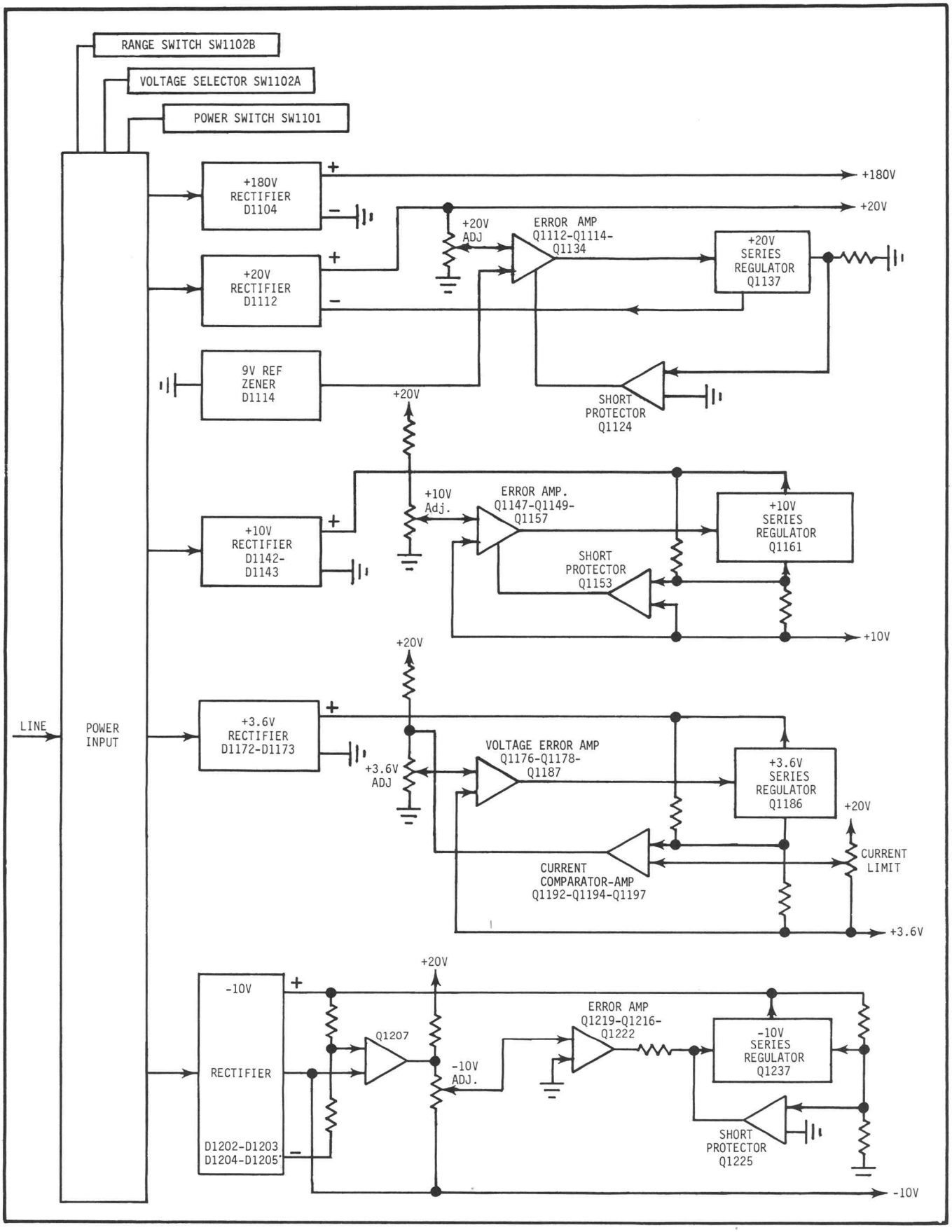


Fig. 2-1. Block Diagram of the Power Supply.

+20-Volt Power Supply

The +20-Volt supply (see Fig. 2-2) provides the reference voltage for the other supplies. The output from the secondary of T1101 is rectified by bridge rectifier D1112. This voltage is filtered by C1112 and then applied to the +20-Volt series regulator stage to provide stable output voltage. The series regulator stage can be compared to a variable resistance which changes to control the output current. The current through the series regulator stage is controlled by the error amplifier, providing the correct regulated output voltage. Reference voltage for the comparator is provided by zener diode D1114, which sets the base of Q1112 at about +9 volts. The base level of Q1114 is determined by voltage divider R1120-R1121-R1122. R1120 is adjustable to set the output voltage of this supply at +20 volts. Comparator Q1112-Q1114 responds to the change that R1120 presents to the base of Q1114, allowing the output current of the error amplifier stage to control the conduction of the series regulator stage.

This output current maintains equal voltages at the bases of Q1112 and Q1114. This occurs as follows:

If the +20 volts adjustment (R1120) is turned counterclockwise, Q1114 base and Q1112-Q1114 emitters tend to go more positive than the base of Q1112. The current through Q1112 increases. Increased current through Q1112 produces more voltage drop across R1125 and the base of Q1134 goes positive. This results in a decrease in current through Q1134, and the base of Q1137 moves negative. Current decreases through Q1137 and the load, so the output voltage decreases. This reduces the voltage across divider R1120-R1121-R1122 which returns the base of Q1114 to about +9 volts. A similar but opposite action takes place when R1120 is turned clockwise.

The output voltage is regulated to provide a constant voltage to the load by feeding a sample of the output back to the series regulator (Q1137). For

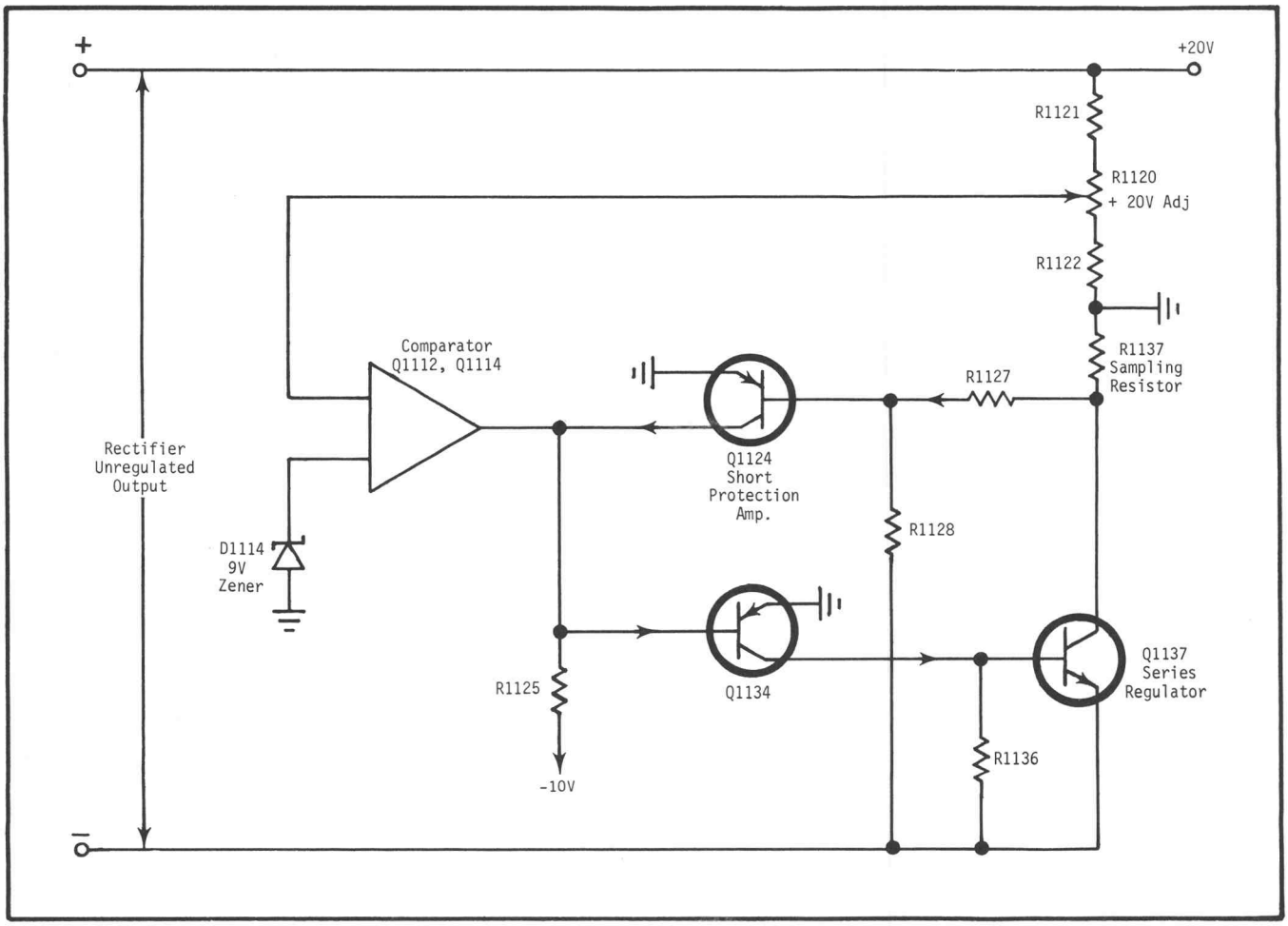


Fig. 2-2. Simplified diagram of the +20-Volt regulator.

example, assume that the output voltage increases (more positive) because of a change in load or line voltage. The increasing voltage at the output is applied across voltage divider R1120-R1121-R1122, and the base of Q1114 goes positive. This reduces the current flow through Q1114. Increasing current through Q1112 causes its collector to go positive. When the collector of Q1112 goes positive, the bias on Q1134 is decreased, allowing the base of Q1137 to go more negative. Reducing current through Q1137 decreases the current through the load and the output voltage decreases (less positive). In a similar manner, the series regulator and error amplifier stages compensate for the output changes due to ripple. The short protection amplifier stage (Q1124) protects the +20-Volt supply if the output is shorted to another supply or to ground. For normal operation, the emitter base voltage of Q1124 is not enough to bias it on. When the output is shorted, high current flows through R1137. The voltage drop across R1137 becomes sufficient to forward bias Q1124 and its collector current produces an increased voltage drop across R1125. The increased voltage drop across R1125 reduces the current flow of both Q1134 and Q1137 to limit the output current. Further limiting of the output current is provided by voltage divider R1127 and R1128, which senses the increase in unregulated voltage across Q1137 and adds to the increasing base current of Q1124. This results in a further decrease of current through R1137 and Q1137.

+10-Volt Power Supply

Full-wave rectified voltage for operation of the +10-Volt supply is provided by D1142-D1143 (see Fig. 2-3). The voltage is filtered by C1143 and connected to the +10-volt series regulator stage to provide a stable output voltage in a manner similar to that described for the +20-Volt supply. For example, assume that the output voltage increases (more positive) because of a change in load or line voltage. This positive-going change is applied to the base of Q1149 through R1151. The current in the differential amplifier (Q1147-Q1149) is shifted and more current flows through Q1149 than through Q1147. The current through R1149 increases, which causes the base of emitter follower Q1157 to go more negative. This in turn causes the emitter of the series regulator transistor to go more negative. This action restores the +10-Volt supply back to the preset value determined by voltage divider R1144-R1145-R1146.

Shorting protection is provided by R1160-R1161-R1162-R1154-R1156 and Q1153. R1154 and R1156 are provided to sense the line voltage relative to the +10-Volt supply. It is desired to limit the current at a lower value at high line voltage than at low line voltage. This provides protection for Q1161. R1160-R1161-R1162 senses the current flowing through Q1161. The base of Q1153 receives a voltage slightly positive compared to

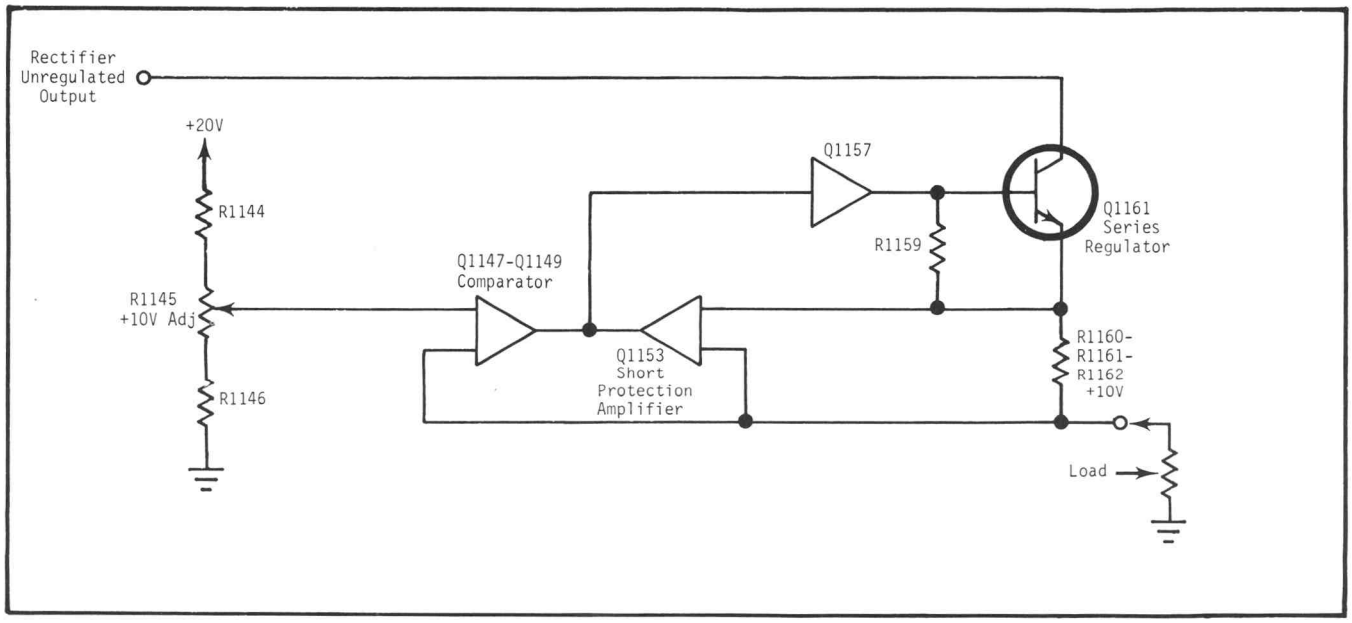


Fig. 2-3. Simplified diagram of the +10-Volt regulator.

the +10 volt output due to the voltage divider action of R1154-R1156. The higher the line voltage, the greater the voltage contribution from R1154-R1156 to the base of Q1153. When sufficient current is drawn from the supply, Q1153 is turned on and the supply voltage collapses because Q1153 has depleted the current available to Q1157 to maintain the supply at +10 volts.

+3.6-Volt Supply

Full-wave rectified voltage for the +3.6-Volt supply is provided by D1172-D1173. The voltage is filtered by C1152-C1153 and connected to the +3.6-Volt series regulator stage which provides a stable output voltage in a manner similar to that described for the +20-Volt supply (see Fig. 2-4).

The short-protection circuit also operates in a manner similar to that described for the +20-Volt supply. The circuit takes a sample of current and applies it as a voltage to a differential amplifier. The amplifier compares the voltage to a preset level and limits the short-circuit current to a fixed value determined by the setting of current limit control R1195. The operation of this short protection circuit is as follows:

When a high current is developed through R1189 due to a short-circuit load, the base of Q1192 is driven positive. Current increases through Q1194, whose base level is preset by current limit control R1195. The voltage drop across R1194 increases, driving the collector of Q1194 more positive. The collector of Q1194 drives the base of Q1197 into conduction (Q1197 is normally turned off). Q1197 then applies a large control voltage to the error amplifier, which limits the current through series regulator Q1186.

—10-Volt Supply

This supply is a dual-voltage supply where full-wave rectified voltage for operation of the -10-Volt supply is provided by D1202-D1203 (see Fig. 2-5). The other supply floating on the -10-Volt supply provides the voltage for the control circuit. D1204-D1205 provides rectification for this additional voltage. The error amplifier and short protection amplifier operate in a manner similar to that described for the +20-Volt supply.

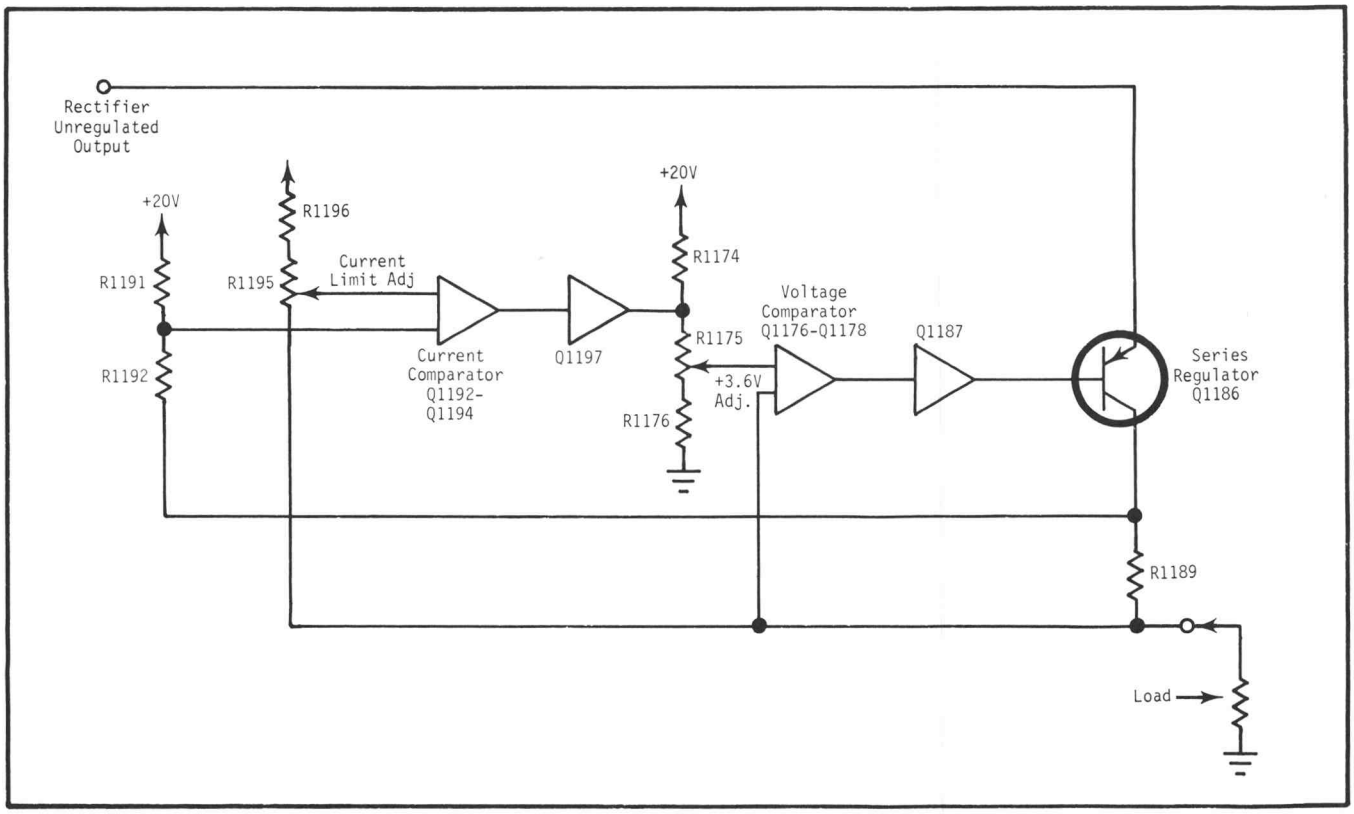


Fig. 2-4. Simplified diagram of the +3.6-Volt regulator.

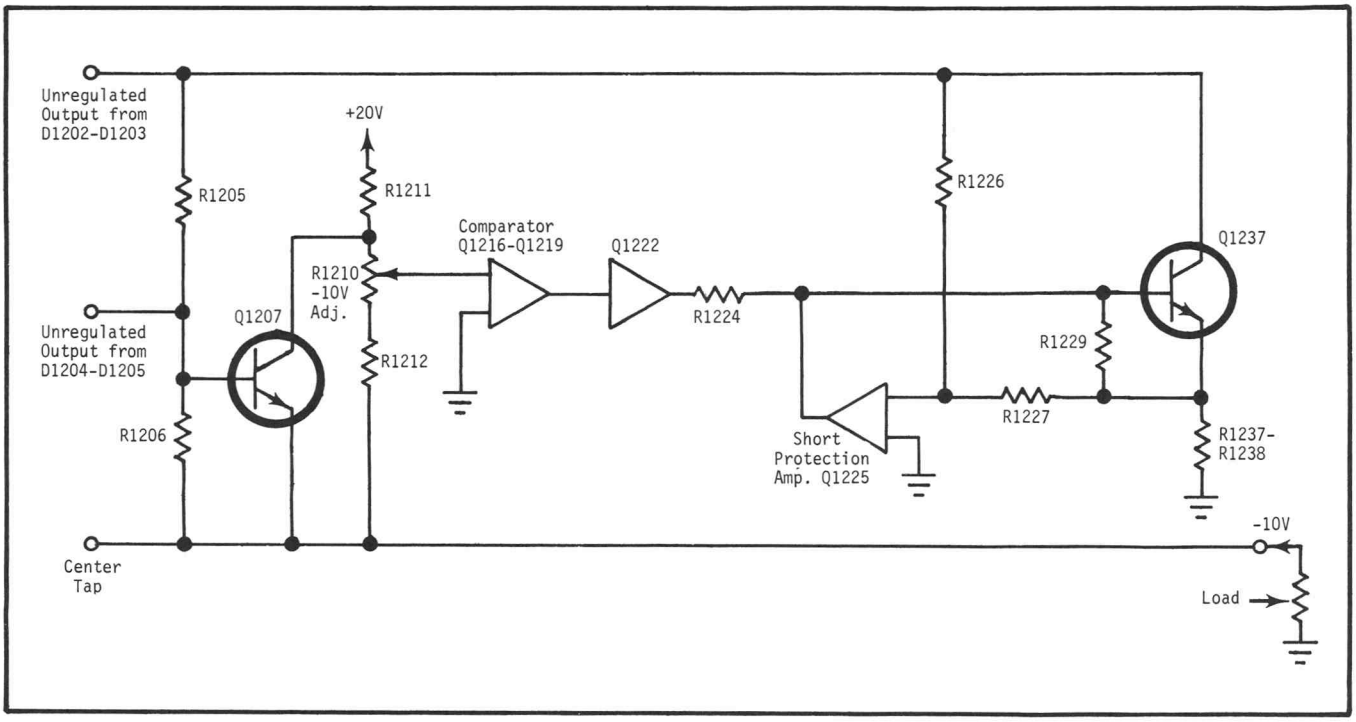


Fig. 2-5. Simplified diagram of the —10-Volt regulator.

Protection to prevent erasure of data in the disc memory is provided by C1205 discharging more rapidly than C1203, causing the base of Q1207 (through D1206) to move more positive. The collector of Q1207 moves negative and turns Q1216 off immediately, ensuring that the -10-Volt supply shuts off first. D1217 provides protection of the supply if it is accidentally shorted to another supply, by clamping the shorted supply near ground.

+180-Volt Unregulated Supply

The Type R250 and Type 240 have power supply configurations that are very similar. However, since the Type R250 has no display tubes requiring high voltage, the +180-Volt Unregulated Supply is unused in the Type R250.

OUTPUT REGISTER

The Output Register is constructed of 48 4-bit shift registers. These registers are located on program assembly circuit cards P1 through P12 in the Type R250[1] (shown on diagrams 5 through 16). The Output Register has a storage capacity of 48 4-bit characters. Each of the 4-bit registers controls 4 program lines to output connectors on the Type R250 rear panel.

Character data without parity bits enters the Output Register at the J12 end from J112 on the Type R250 rear panel. The data is received from the Type 240 via J112. At the J1 end of the Type R250 Output Register, the data leaves the Output Register, goes through J112 and enters the Type 240 Output Register at the J12 end. The shift pulse from the Type 240 enters the Type R250 via J112, where it is sent for amplification and buffering in the shift amplifier circuitry, located on regulator circuit card P13 (see diagram 1). From the shift amplifier, the shift pulse is connected in parallel to the shift input of all 48 shift registers. As each shift pulse arrives and clocks all 48 registers, the data advances one character position through the Output Register.

[1]A Program Assembly circuit card consists of a shift register card plus any combination of two of the Standard Program, Conductance Program, or Resistance Program circuit boards. When a shift register card and two of these boards are assembled together into a complete operating assembly, it is called a Program Assembly circuit card.

Shift Register Operation

The shift registers on each program assembly are connected in the line of data flow so that register U8 stores the "8" data, U4 stores the "4" data, U2 stores the "2" data, and U1 stores the "1" data. Fig. 2-6 shows the data connections for characters 1 through 8 between two example program assemblies.

When the Type R250 power switch is turned on, capacitor C9 is charged through R9 toward +3.6 volts. The change in voltage at R9 sets the registers, which causes all of the register outputs to be true. This off-biases all of the driver transistors in the Standard Program circuit boards, de-energizes all relays on the Conductance Program board, or energizes all relays on the Resistance Program board. These conditions depend upon which type of program board is connected to the shift register. In all cases, when the registers are set, all data inputs to the program boards are true. When a test is stored in the output register, the levels at the shift register outputs control the bases of the driver transistors, or (in the case of the resistance program board) the inputs to the gating circuits. The program is still not effective until the emitters of the driver transistors are enabled. Enabling of the resistance program board circuits is achieved by providing operating current for the gates controlling the driver transistors.

STANDARD PROGRAM BOARD

The Standard Program Board is a buffer inverter board using 8 transistors to control 8 output lines to the programmed instrument. The transistors on the Standard Program Board provide ground closure programming, where a true level is very near ground potential and a false level equals an open collector. Pull-up of program lines can be provided by connection to +3.6 volts or +10 volts on the Standard Program Board. Each collector is provided with a diode in series with the collector and program line, to provide additional isolation when a program line is false. Provision is made on the Standard Program Board for resistance-capacitance circuits designed to hold a line at the true level during a change in program. The size of these RC circuits is determined by the needs of the customer. Control of the program board is provided to the customer via the Enable line. ENABLE controls the emitter level of Q27, the enabling transistor. EXTERNAL INHIBIT, which comes from the Type 240, controls the base of Q27. If the programmed instrument does not provide an Enable, the emitter of Q27 may be patched to ground. The collector of Q27 can be connected by patching to the common emitter line of Q21 through Q28, the common emitter line of Q11 through Q18, or both. If Q27 is not to be used, provision is made on the board for patching the emitters of both sets of transistors to ground.

The Standard Program Board comes equipped with parts to aid in the construction of the program assembly. The 750 Ω 1/4 W resistors included in the kit are normally used to connect between the standard program transistor bases and the corresponding lines from the output of the shift register.

The 130 Ω resistor included in the kit is to be connected to the base of Q27. Terminal connector links also supplied in the kit are wires with insulation over a short portion. These links are used to provide connections between the various patch points on the standard Program Board. For instance, if Q27 is to be used to control Q21, Q24 and Q28, a terminal connector link should be soldered across the points labeled "E2".

CONDUCTANCE PROGRAM BOARD

The Conductance Program Board may be used when digital-to-analog conversion is required due to the nature of the programmed equipment. The board as shipped consists of an enabling transistor and 8 buffer inverter transistors, each controlling a relay. Each relay, when energized, inserts a resistance into a parallel resistance matrix. The size of the resistors is determined by the needs of the programmed instrument. All inhibiting and enabling of the two banks of transistors is done in a fashion similar to that described on the Standard Program Board.

An RC network in the collector circuit of each driver transistor and the diode across the relay coil provide delays in opening and closing of the relay reeds. The delay is necessary for two reasons: When changing programs, the delay reduces reed wear by holding the reeds from changing state until the new program arrives. Also, damage to external equipment is prevented by causing opening reeds to open before closing reeds can close. Table 2-1 shows the typical operating time of the reeds.

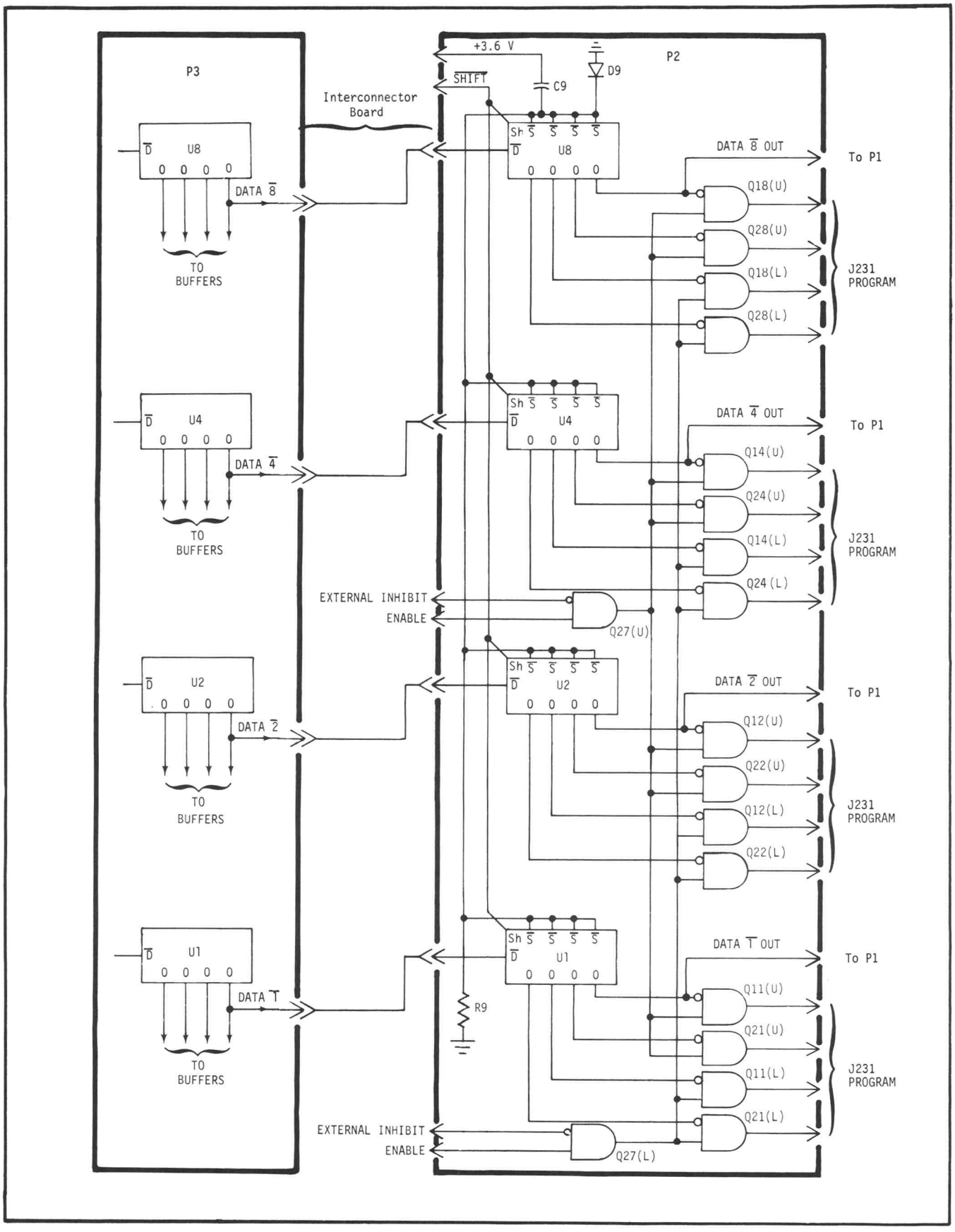


Fig. 2-6. Data connections in the Output Register.

Table 2-1
Reed Operating Time (Conductance Program)

Open to Closed	450 microseconds after new program is enabled
Closed to Open	325 microseconds after old program is inhibited

Typically, the loading time for a test from the disc memory is no more than 250 microseconds. The minimum loading time for a tape operation is about 160 milliseconds; for an examine/modify operation, about 8 milliseconds. Therefore, the reed operating delays are useful for disc memory operations only.

RESISTANCE PROGRAM BOARD

The Resistance Program Board is to be used when digital-to-analog conversion is required. As in the Conductance Program Board, the resistor sizes are to be selected by the customer and the resistors must be installed in the board prior to operation. The resistance matrix is set up in a fashion such that BCD programming may be accomplished using exactly the same size resistors in each position. An RC network is installed in each collector circuit to hold a relay energized during a change in program.

An RC network in the collector circuit of each driver transistor provides delayed opening and closing of the relay reeds. The delay is necessary for two reasons: When changing programs, the delay reduces reed wear by holding the reeds from changing state until the new program arrives. Also, damage to external equipment is prevented by causing closing reeds to close before opening reeds can open. Table 2-2 shows the typical operating time of the reeds.

Table 2-2
Reed Operating Time (Resistance Program)

Open to closed	550 microseconds after old program is inhibited
Closed to open	1.2 milliseconds after new program is enabled

Typically, the loading time for a test from the disc memory is no more than 250 microseconds. The minimum loading time for a tape operation is about 160 milliseconds; for an examine/modify operation, about 8 milliseconds. Therefore, the reed operating delays are useful for disc memory operations only.

Gating circuitry between the shift register and the transistor drivers permits the selection of 8-4-2-1 binary or BCD control of the transistor drivers. When a terminal connector link is installed at position "L1," the transistor drivers are operated in a BCD fashion. That is, any combination of register inputs exceeding the decimal 9 is effectively ignored by the controlling circuitry. If BCD programming is used, all selected resistors must be of equal value. When resistors are selected in this fashion, the programming sequence essentially follows the 1-2-4-2 code. Using terminal connector links, the control gates may be patched to the collector of enabling transistor Q187. This permits the enable line from the programmed equipment to control the status of the gates. If Q187 is not used, a terminal connector link should be installed at positions "D1" and "D2" to provide ground for the gates.

NOTES

SECTION 3
MAINTENANCE

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The Type R250 is a carefully designed instrument, constructed to give dependable performance for a long time without a great deal of specialized maintenance. However, any precision instrument requires reasonable care, and observation of the routine maintenance procedures outlined in this section will help to assure maximum usefulness of the Type R250 and the system in which it operates.

At various points throughout the section there are warnings and cautions provided to assist the maintenance man in avoiding personal injury and equipment damage. It is suggested that these special notices be read carefully and followed scrupulously wherever applicable.

List of Topics

The following information is contained in this section in the order listed:

ROUTINE MAINTENANCE

General. Routine maintenance consists of cleaning, lubricating, visually inspecting and calibrating the equipment. The Type R250 should be checked every 1000 hours of operation or every six months, whichever occurs first. If the instrument is subjected to adverse environmental conditions (excessive dust, high temperature, high humidity), routine maintenance should be performed more often.

Cover Removal and Front Panel Mechanical Maintenance

Cover Removal. The top and bottom dust covers can be removed quickly for access to the internal circuitry. They are secured to the frame with slotted-head fasteners that can be released by turning them 1/4 turn counterclockwise. The covers can then be lifted off. Whenever possible, the covers must be kept on the equipment to keep out dust and to provide proper air flow.

Each of the lower side panels can be taken off after removing 5 screws from the side and 5 from the bottom. However, the chassis section of the slide-out track assembly must be removed to permit access to one of the side screws.

Front Panel. The front panel is hinged and can be opened for access to the circuit cards, front panel switch, etc. To open it, unscrew the two slotted thumbscrews at the left side of the front panel and swing the front panel out and to the right.

The hinges should be positioned so that the panel securing screws are aligned with their receivers when the panel is swung shut. To align the front panel, loosen one of the hinge-fastening nuts which are located on the inside of the panel. Shift the hinge position as necessary for proper alignment and then retighten the nut. Repeat at the other nut if necessary, and then recheck the tightness of the first nut. If both nuts are loose at the same time, the front panel can slip off of its hinges.

Cable Extender. The cable extender assembly which is associated with the front panel should be positioned so that neither it nor the cable rub the

instrument when the front panel assembly is swung open or closed. In addition, the extender should prevent the door from opening so far as to strike the front handle when the instrument is rack-mounted.

Retainer Bar. When the front panel is closed, a retainer bar presses against the plug-in circuit board assemblies to hold them in place. The bar should be positioned so that it does not exert excessive forward or side pressure when the front panel is closed securely. To adjust the bar, swing out the front panel and loosen the bar mounting screws until the bar is slip tight. Check that all of the cards are inserted fully, and then close the door. Fasten the door-holding screws. Remove the instrument's top cover. Exert gentle pressure on the front of the left side of the retainer bar, pressing it against the circuit cards. Using a #2 phillips screwdriver, tighten the left mounting screw. Repeat at the right side.

Cleaning

Clean the instrument often enough to prevent accumulation of dirt. Dirt on the components deters heat dissipation and it may provide electrical conducting paths.

Air Filter. Under normal operating conditions the air filter should be checked every few weeks and cleaned if dirty. More frequent cleaning may be required if the instrument is used in a dusty environment. Remove the filter by pulling it out of the frame on the rear of the instrument. To clean the filter, wash it thoroughly in a mild detergent solution. Rinse the filter in clear water and let it dry; then coat it with an air-filter adhesive available from air-conditioner suppliers or from Tektronix (Part No. 066-0058-00). Let the adhesive dry thoroughly before re-installing the filter.

Exterior. The outside of the instrument can be cleaned by wiping with a soft cloth. Hardened dirt or grease may be removed with a soft cloth dampened in a solution of water and mild detergent. Abrasive cleaners should not be used.

Interior. Clean the interior of the instrument by loosening the accumulated dust with a dry, soft brush. Remove the loosened dust by vacuum or by blowing it out with a low-velocity stream of air. Any remaining dirt may be removed with a cloth or a cotton-tipped applicator dampened with a solution of water and mild detergent. After cleaning, allow the instrument to dry thoroughly before turning it on.

The plug-in circuit cards should be removed for individual cleaning. If the plug-in contacts are corroded or dirty, they can be cleaned with a non-abrasive soft rubber eraser.

Lubrication

Fan Oiling. During periodic servicing, the fan motor should be lubricated with a few drops of light machine oil (Anderol L826 available from Lehigh Company or Rotron Distributors is recommended). An industrial hypodermic needle and syringe is used to insert the oil through the rubber seal, as shown in Fig. 3-1. Hold the syringe at a 45° angle, pierce the rubber seal, then insert the needle about 1/4 inch and depress the plunger far enough to inject 3 or 4 drops of oil into the bearing. If a syringe and needle cannot be obtained locally, they may be ordered from Tektronix (Tektronix Part No. 003-0282-00 for the syringe; 003-0285-00 for the needle).

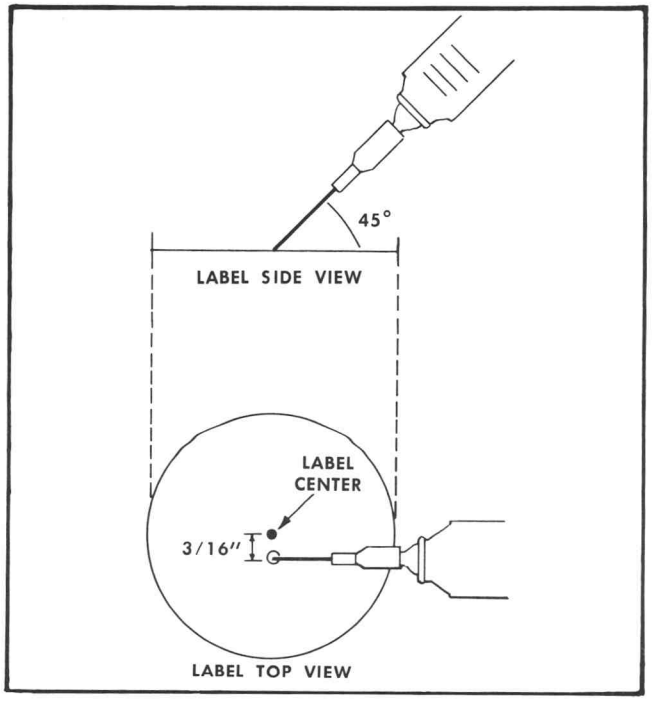


Fig. 3-1. Oiling the fan with a hypodermic syringe.

Visual Inspection

After cleaning, the instrument should be carefully checked for defects such as poor connections, damaged parts, and improperly seated transistors and integrated circuits. The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, determine the cause of over-heating before the damaged parts are replaced. Otherwise the damage may be repeated.

Transistor and Integrated Circuit Checks

Periodic checks of individual transistors and integrated circuits are not recommended. The best check of these components is their operation in the equipment, as reflected by a performance check or calibration procedure. Sub-standard performance will normally be detected at that time.

Recalibration

To insure correct and accurate measurements, the instrument calibration should be checked each 1000 hours of operation or at least once every 6 months. A Calibration procedure is given in a separate section of this manual.

The calibration procedure can be helpful in isolating major troubles in the instrument. In addition, minor troubles which are not apparent during normal operation may be revealed and corrected during calibration.

CORRECTIVE MAINTENANCE

General. Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures which are required to replace components in this instrument are described here.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical replacement parts for the Type R250 can be obtained through Tektronix Field Offices or representatives. However, many of the standard electronic components are available from local electronic parts stores. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the Type R250. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured specifically for Tektronix. These special parts are indicated in the Parts List by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from the factory, include the following information:

1. Instrument Type and serial number.

2. Description of the part. Include circuit numbers of electrical components.

3. Tektronix Part Number.

Soldering Techniques

CAUTION

Disconnect the instrument from the power source before soldering.

Circuit Card/Board Soldering. Circuit card assemblies should be removed from the instrument before any soldering is done on them. They should be placed in a holder which permits access to both sides.

Use ordinary 60/40 tin-lead solder and a 25 to 40 watt pencil-type soldering iron. A higher wattage iron may separate the etched wiring from the base material. The tip of the iron should be clean and properly tinned to provide quick heat transfer to the solder connection.

The following technique is suggested for replacing a component on a circuit card or board:

1. Grip one lead of the component with a pair of needle-nose pliers. If the component is known to be defective, the leads may be cut near the component body for individual removal. If the leads are inaccessible (such as on bases for integrated circuits and transistors), a vacuum-type solder removing tool will be required. One can be purchased from Tektronix by Part No. 003-0428-00.

2. Touch the tip of the soldering iron to the connection at the back of the board, then gently pull the lead out of the board and remove the soldering iron. This method will not always work on devices which have more than two leads. Those devices can be removed after the solder is extracted from all of the connections. Heat each connection and remove the solder by using the previously mentioned vacuum-type solder removing tool. Then pull the component out. Apply additional heat to the connections as necessary to completely free them.

3. Clean holes should be left in the board after the leads are removed. If not, reheat the area and remove the solder. Either the vacuum-type tool or a sharp non-metallic object (such as a toothpick) can be used.

4. Clean the leads of the new component (if necessary) and bend them to fit the holes in the circuit board.

5. Insert the leads into the holes, making certain that the component fits in the same manner as the original. If it does not, reheat the connection and move the component into place.

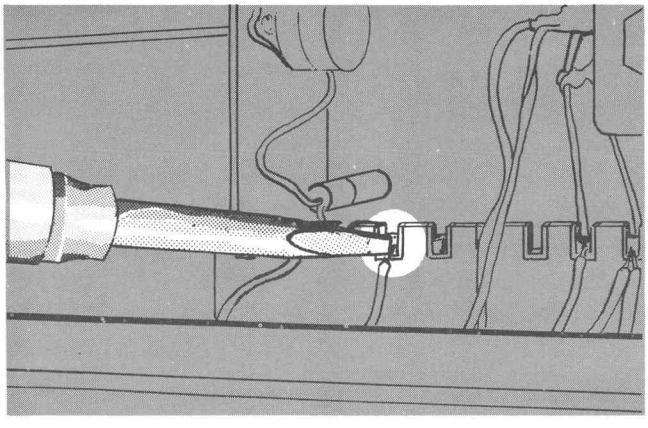


Fig. 3-2. Proper method of applying heat to a ceramic terminal strip.

6. Apply the soldering iron and a small amount of solder to the connection at the back of the board. (On some boards it may be necessary to do the soldering on the component side of the board.) Apply the solder to the connection, not to the iron. Use only the amount of solder required to form a good electrical connection.

7. Ensure that the solder has bonded to the wire. This can usually be checked by observing that a small amount of solder has flowed up the wire on the opposite side of the board.

8. Cut off the ends of the wires.

Soldering on Ceramic Terminal Strips. Solder containing about 3% silver should be used for soldering on ceramic terminal strips. (A spool containing a small amount of this solder is fastened on the Power Supply chassis, near the C1172 connections.) Occasional use of ordinary 60/40 tin-lead solder is permissible, but its repeated use on a connection, or the application of excessive heat, will break the silver-to-ceramic bond in the terminal notch.

Silver-bearing solder is available locally from electronic distributors or may be purchased in 1-pound rolls from Tektronix Field Offices. Order by Tektronix Part No. 251-0514-00.

Use the following technique when soldering on a ceramic terminal strip:

1. Use a 40 to 75 watt soldering iron with a chisel-shaped tip.

2. Clean and tin the tip of the iron with silver-bearing solder.

3. Apply heat to the connection by touching the soldering iron tip to the side at the base of the notch. See Fig. 3-2. Do not apply excessive pressure or wedge the tip of the iron into the notch.

4. Use the minimum amount of heat required to make the solder flow freely.

5. Apply only enough solder to cover the leads;

do not attempt to fill the notch with solder.

6. Cut off any excess lead lengths extending beyond the connection and clean the ceramic strip with a flux-removing solvent.

Metal Terminal Soldering. Use ordinary 60/40 tin-lead solder for soldering to metal terminals such as switch or connector terminals. A soldering iron with a 40 to 75 watt rating should be used and the tip of the iron should be properly cleaned and tinned.

Use the following techniques to remove leads or solder them to metal terminals:

1. Hold the lead with a pair of long-nosed pliers. Be careful not to damage the insulation.

2. Apply the soldering-iron tip directly to the connection until the solder begins to melt. Then gently remove the lead. Do not apply excessive heat or pressure.

3. Pre-tin all leads to be soldered to a connector terminal by heating the leads and coating them with a small amount of solder.

4. Use a minimum amount of solder to form a good electrical connection. Excessive solder may impair the operation of the component or form a cold solder joint.

Other Soldering Considerations. Use heat sinks when soldering on components which have short leads. Alligator clips or long-nosed pliers serve as excellent heat sinks. See Fig. 3-3.

After soldering any connection, cut off the excess length of the soldered lead. Be sure that the ends are not dropped into the instrument. They could cause electrical short-circuits.

Replacement Procedures

Ceramic Strip Replacement. To remove a damaged ceramic terminal strip, first unsolder all connections, then pry the mounting studs out of the chassis. See Fig. 3-4. The studs can also be removed by tapping on the ends which protrude from the reverse side of the chassis. Another way to remove a ceramic strip is to

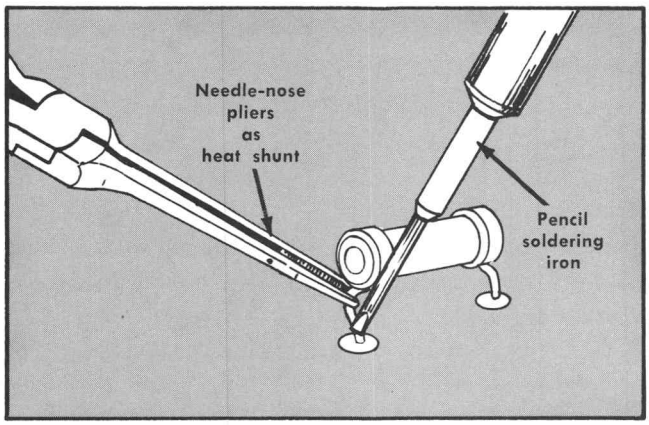


Fig. 3-3. Use of heat shunt to protect components during soldering.

cut off one side of each stud with diagonal cutters. (Replacement strips are supplied with mounting studs attached.) The remainder of the studs can then be pulled out after the strip has been removed. If the nylon spacers do not come out with the studs, they may be left in the chassis or pulled out separately. The spacers, if not damaged, can be used with the new ceramic strip assembly.

After the damaged strip and stud assembly have been removed, place the spacers into the mounting holes in the chassis and press the new mounting studs into the spacers. It may be necessary to tap lightly or

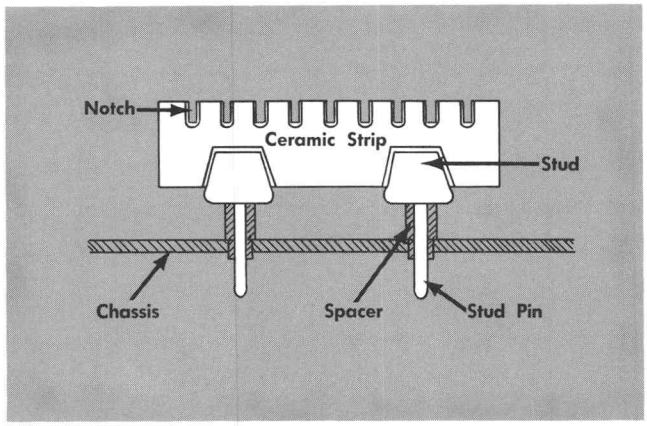


Fig. 3-4. Ceramic terminal strip assembly.

otherwise apply pressure to the ceramic strip to make the studs seat all the way down into the spacers. To avoid damage to the terminal strip, use a soft-tipped tool for tapping, and apply force only to the portion of the strip directly above the mounting studs. Cut off the excess length of the mounting stud pin which extends beyond the ends of the spacers. Resolder all components and wires in place, using the previously

explained technique. Attempt to duplicate the original arrangement of parts and leads.

Circuit Card/Board Replacement. If any of the circuit cards or boards become damaged and cannot be repaired, a replacement should be obtained. Each program assembly consists of two circuit boards connected to a circuit card. Tektronix Part Numbers for the separate boards are as follows:

1. The empty boards have 388- part numbers as etched on the boards.
2. The boards with only the soldered-on components in place have 670- part numbers, found in the board parts lists near the end of this section.
3. Complete board kits with plug-in components and associated parts have 020- part numbers, given in the Optional Accessories list on the Accessories fold-out.

CAUTION

Do not remove plug-in circuit cards while the equipment is energized. Never energize the equipment while plug-in circuit cards are installed in jacks other than those for which they are marked. The Type R250 or interconnected equipment may become damaged.

Transistor and Integrated Circuit Replacement. Transistors and integrated circuits (ICs) should not be replaced unless they are actually defective. Replacement or exchange of components may affect the calibration of the instrument. If a transistor or integrated circuit is removed during routine maintenance, return it to its original socket.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket and cut the leads to the same length as on the component being replaced. Use Fig. 3-5 as a reference for insertion.

A tool should be used to remove in-line integrated circuits. A component extracting tool, AUGAT No. T114-1 (Tektronix Part No. 003-0619-00), is designed specifically for that purpose. The tube puller listed under Tektronix Part No. 003-0167-00 can also be used satisfactorily. If the devices are removed without using a tool, pull up slowly and evenly. Use care to see that one end does not disengage suddenly, causing the pins on the other end to bend.

The chassis-mounted power supply transistors and diodes and their mounting bolts are insulated from the chassis. In addition, silicone grease is used to increase heat transfer capabilities. Re-install the insulators and replace the silicone grease when replacing these transistors. The grease should be applied to both sides of the mica insulators, and should be applied between Q1186 and its heat sink. The heat dissipator which encapsulates Q1222 also contains a film of silicone grease. To replace the transistor, unplug the assembly from the socket. Then unscrew the top section of the dissipator. Extract the transistor. Apply a film of silicone grease to the replacement transistor and re-install it in the dissipator. Plug the assembly into its socket.

WARNING

1. *Silicone grease can be harmful to personal health. Avoid prolonged contact with it. Do not permit it to touch the eyes. Thoroughly wash areas concerned after exposure to it.*
2. *Voltage is present on the exterior surface of most of the metal-cased semiconductors.*

After any component is replaced, check the operation and calibration of the associated circuits.

Terminal Connector Links. These links, which consist of short pieces of slightly kinked wire inserted through short pieces of insulation, are used extensively on the plug-in circuit cards. They provide convenient connections while minimizing the possibility of short circuits.

Reed Switches. The plug-in relay assemblies are polarized and should be installed so that the plastic locating pin is aligned with the corresponding hole in the board. The assembly will not seat properly if installed backward. Use care in handling the assemblies, for they are delicate and should not be subjected to excessive shock. To replace a reed switch:

a. Using a tube puller, lift straight up on the defective assembly. Take care not to bend the clips on the parent board.

b. Using a toothpick or sharp instrument, push the reed switch out either end of the coil. The reed

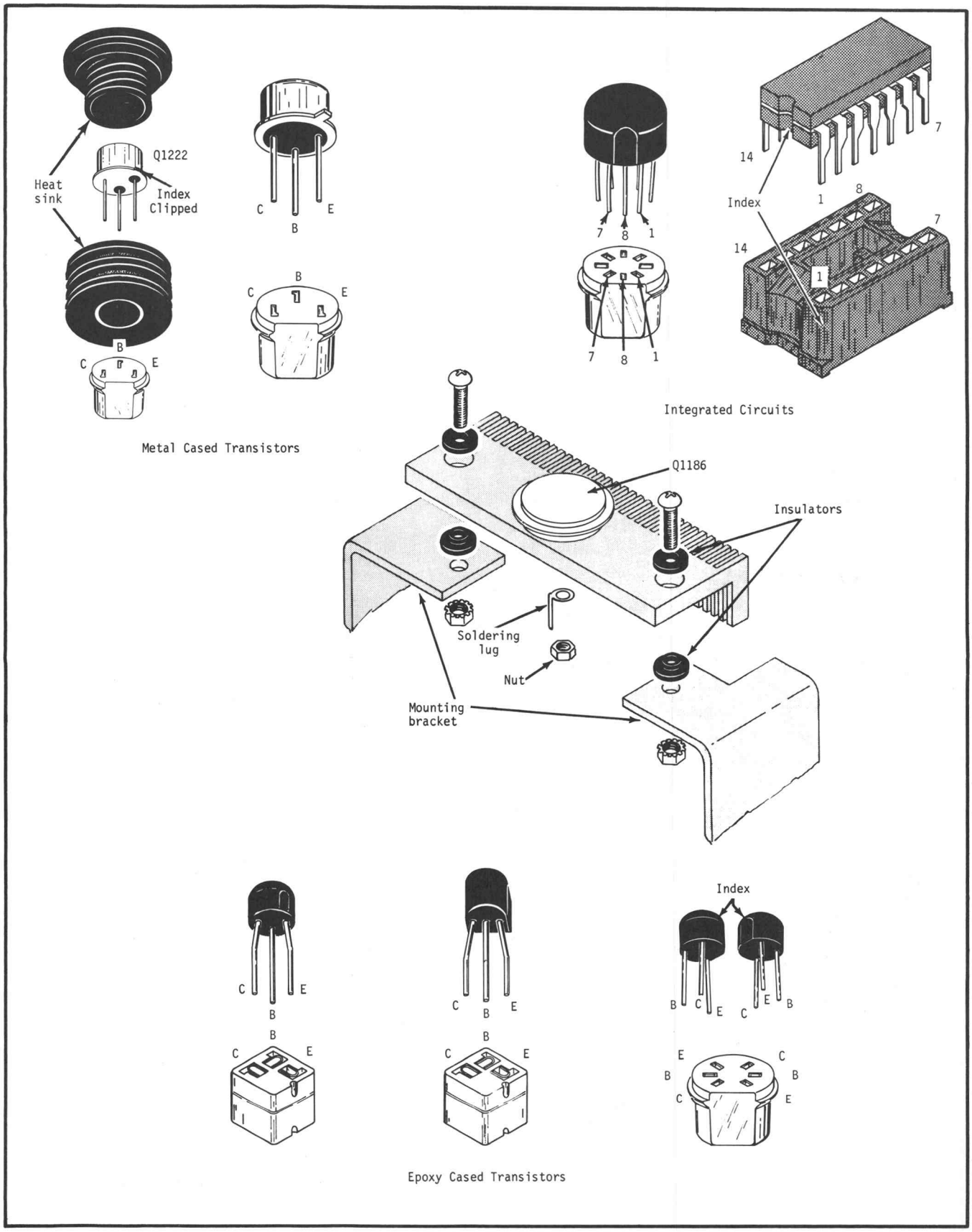


Fig. 3-5. Semiconductor installation information. See text for additional information regarding insulation and silicone grease.

and holding block will slide out of the other end. (See Fig. 3-6.)

c. Slide the replacement reed switch into the opened end of the assembly and replace the holding block.

d. Re-install the repaired assembly on the parent board.

Indicator Lamp Replacement. The plug-in Power On lamp on the front panel can be removed out the front of its holder. To remove the lamp, grip it just behind the lens with the fingernails and pull outward. To install a new lamp, align the lamp pins with the socket pins and push the lamp into place.

Miscellaneous. The front panel face plate need not be removed for any purpose other than its own replacement. A special 12-sided wrench is required for removing the Power switch. This wrench is available under Tektronix Part No. 003-0306-00.

TROUBLESHOOTING

General. The following information is provided to aid in locating and correcting trouble in the Type R250. Information in the Circuit Description, Calibration and Diagrams sections is also helpful when troubleshooting the instrument. Plug-in circuit card extenders are available by Tektronix Part Numbers 670-0240-00 and 670-0241-00 (both required), and can be used to permit access to the plug-in circuit cards during operation. However, care must be used to avoid personal shock or equipment damage when they are in use. For detailed troubleshooting procedures, refer to the Type 240 instruction manual.

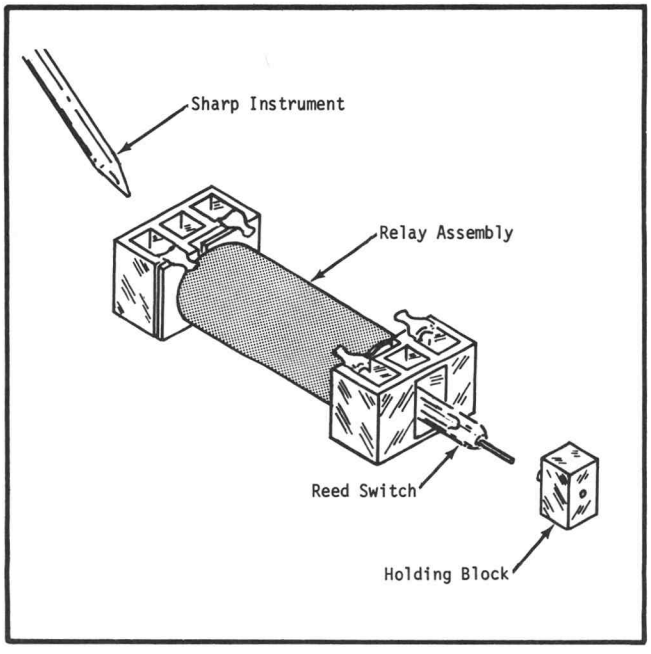


Fig. 3-6. Removal of Reed Switch.

Troubleshooting Aids

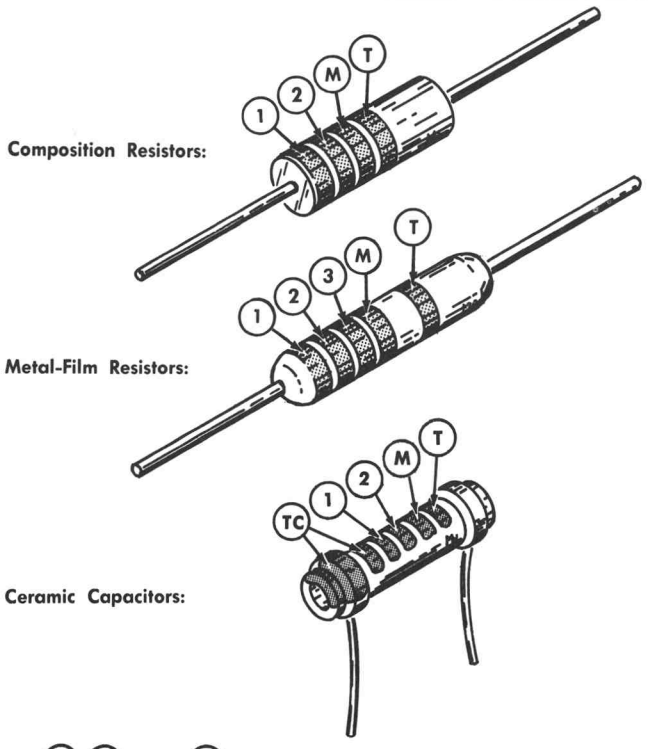
Diagrams. Circuit diagrams are given in foldout pages at the back of this manual. The circuit numbers and electrical values of components, as well as significant voltages are shown on the diagrams. All front-panel and internal controls are given and all input and output connections are indicated.

Circuit Boards. The illustrations at the rear of this section show the circuit boards used in the Type R250. Each electrical component is identified by its circuit number. Test points are also indicated. The circuit boards are outlined on the schematic diagrams with a blue line. The use of these illustrations along with the diagrams will aid in locating test points and components mounted on the circuit boards.

Wire Color Code. All insulated wires in the Type R250 are color coded to aid in circuit tracing. Wires containing positive voltages have a white background and those containing negative voltages have a tan background. Additional stripes are used to further differentiate between wires. Examples of power supply wire color codes follow:

+10 V	brn, blk, brn on wht
-10 V	brn, blk, brn on tan
+3.6 V	blue, orn on wht
+20 V	red, blk, blk on wht
+200 V	brn, grn, blk on wht

Resistor Color Code. In addition to the brown composition resistors, metal film resistors (identifiable by their grey or light blue color) are used in the Type R250. The resistance value of composition and metal film resistors is color coded on the components with the standard EIA color code. The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes consisting of two significant figures, a multiplier and a tolerance value. (See Fig. 3-7.)



Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier		Tolerance	
		Resistors	Capacitors	Resistors	Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% −0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% −20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 3-7. Standard EIA color coding for resistors and capacitors.

Capacitor Markings. The capacitance value of common disc capacitors and small electrolytics is marked in microfarads on the side of the component body. The white ceramic capacitors used in the Type R250 are color coded in picofarads using a modified EIA code (see Fig. 3-7).

Diode Color Code. The cathode end of each glass-enclosed diode is indicated by a stripe, a series of stripes, or a dot. For metal-encased diodes, the anode and cathode are indicated by the direction in which the diode symbol is marked on the case. When the diode is JEDEC registered, a series of stripes indicates the diode type number using the EIA color-code system. On diodes which are manufactured especially for Tektronix, a four-band color code system is used, the first band of which is either blue or pink. On the latter type of diodes, the last three bands identify the diode within a class of part numbers. (For example, a diode color coded blue-brown-grey-green probably indicates Tektronix Part Number 152-0185-00.) When in doubt, consult the Parts List.

Semiconductor Tests

Most circuit failures result from the failure of a transistor, diode, or integrated circuit due to normal aging and use. The following paragraphs explain various methods of checking semiconductor devices. Insertion information is provided in Fig. 3-5.

Transistor Checks. Transistor defects usually take the form of the transistor opening, shorting, or developing excessive leakage. The best method of checking transistors is by direct substitution. Be sure the voltage conditions of the circuit are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester (such as a Tektronix Type 575).

Static-type testers are not recommended since they do not check the device under operating conditions. However, if no other tester is immediately available, an ohmmeter will usually indicate when a transistor has failed completely. As a general rule, use the R X 1 k range where the current is usually limited to less than 2 mA and the internal voltage is usually 1 1/2 volts. Check the current and voltage of the ohmmeter by inserting a multimeter between the ohmmeter leads and measuring the current and voltage of the various ranges. After it has been determined which ohmmeter ranges will not harm the transistor, use those ranges to measure the transistor's resistance. Check the resistance in both directions through the junctions as listed in Table 3-1.

TABLE 3-1
Transistor Resistance Checks

Ohmmeter Connections[1]	Resistance Readings that Can Be Expected Using the R X 1 k Range
Emitter-Collector	High readings both ways (about 60 kΩ to around 500 kΩ).
Emitter-Base	High reading one way (about 200 kΩ or more). Low reading the other way (about 400 Ω to 2.5 kΩ).
Base-Collector	High reading one way (about 500 kΩ or more). Low reading the other way (about 400 Ω to 2.5 kΩ).

Integrated Circuit Checks. Integrated circuits are best checked in the circuit with a voltmeter, oscilloscope, or by direct substitution.

Diode Checks. Diodes (except for tunnel diodes) can be checked for an open or short-circuited condition by measuring the resistance between the terminals after unsoldering one end of the component. Use a resistance scale with an internal voltage between 800 mV and 3 volts. The resistance should measure very high (in megohm range) in one direction, and low in the other.

[1]Test prods from the ohmmeter are first connected one way to the transistor leads and then the test prods are reversed (connected the other way). Thus, the effects of the polarity reversal of the voltage applied from the ohmmeter to the transistor can be observed.

Circuit Troubleshooting

Effective troubleshooting is greatly dependent on the individual's knowledge of the instrument and its operation. It is also dependent upon employing a logical troubleshooting procedure, such as that which follows.

Check that the line voltage is compatible with the voltage selected at the rear panel. Check the setup of the associated equipment, and check all cable connections before attempting any circuit troubleshooting. In addition, ensure that all interconnected equipment is operable. Check that the plug-in circuit cards are in the proper jacks and fully inserted. Trouble may often be partially located by analyzing all symptoms thus obtained.

Power supply voltages and ripple should be checked before a detailed circuit analysis is performed. Erratic operation may be due to intermittent failure of power supply regulation. This type of failure can often be disclosed by observing each regulated voltage while varying the AC input voltage through the equipment operating range. An autotransformer can be inserted between the line source and the Type R250 to permit the input voltage variation. Loose mounting nuts on power supply diodes and transistors, or improper installation of associated insulators can also cause erratic power supply operation or total failure.

Observe the following precautions during circuit troubleshooting:

Voltage is often present on the outside of metal-cased transistors. Avoid accidental contact with them.

Plug-in circuit cards are not interchangeable except as marked on the identifying strips.

Do not remove or insert plug-in circuit cards while the equipment is energized.

Do not operate the Type R250 while any plug-in circuit card is absent.

Voltage dangerous to life is present within the power supply assembly and on the rear of the front panel. It may also exist on circuit cards when a circuit failure exists in the equipment. Use appropriate precautions.

Do not permit any circuitry to "dangle" while it is energized unless precautions are used to prevent it from contacting persons or metallic parts of the equipment.

Known-good plug-in cards, semiconductor devices, capacitors, etc., can be substituted for suspected cards or components as a fast check. The substitution method should only be used after it has been determined that the circuit is safe for the substituted components.

In-circuit voltage and oscilloscope checks are the best method for checking integrated circuit operation. Plug-in extender cards, Tektronix Part No. 670-0240-00 and 670-0241-00 (both required), should be used to aid in checking voltages and waveforms on plug-in cards. The extenders are supplied as standard accessories to the Tektronix Type 230 Digital Readout instrument. They can also be purchased separately through Tektronix Field Offices.

PROGRAM BOARDS

Electrical and Mechanical parts lists for the Shift Register circuit card and for the program circuit boards are given on the following pages. Component locations are shown in the photos at the end of this section.

NOTES

SHIFT REGISTER CARD

ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
				Capacitors	
Tolerance ±20% unless otherwise indicated.					
C2	290-0136-00			2.2 µF Elect. 20 V	
C8	290-0136-00			2.2 µF Elect. 20 V	
C9	290-0247-00			5.6 µF Elect 6 V	10%
				Diode	
D9	*152-0185-00			Silicon Replaceable by 1N4152	
				Resistor	
R9	315-0102-00			1 kΩ 1/4 W	5%
				Integrated Circuits	
U1	156-0016-00			Shift Reg. Replaceable by Fairchild µL997	
U2	156-0016-00			Shift Reg. Replaceable by Fairchild µL997	
U4	156-0016-00			Shift Reg. Replaceable by Fairchild µL997	
U8	156-0016-00			Shift Reg. Replaceable by Fairchild µL997	

MECHANICAL PARTS LIST

Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
334-1272-00			3		LABEL, blank, circuit board
344-0149-00			1		TIE STRIP, angle shape, 6 inches long
211-0142-00			4		SCREW, machine, 4-40 x 0.25 inch, PHS
210-0406-00			4		NUT, hex., 4-40 x 3/16 inch
211-0143-00			7		SCREW, machine, 4-40 x 0.375 inch, PHS
210-0586-00			7		NUT, keps, 4-40 x 1/4 inch
344-0148-00			2		TIE STRIP, 5.751 x 1.0 inch
670-0269-00			1		ASSEMBLY, circuit
- - - - - -			-		card--SHIFT REGISTER
- - - - - -			-		assembly includes:
388-0915-00			1		BOARD, circuit
136-0269-00			4		SOCKET, 14 contact,
- - - - - -			-		circuit board

STANDARD PROGRAM BOARD

ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part. No.	Serial/Model No. Eff	Disc	Description		
	*670-0274-00			Complete Board		
				Diodes		
D11	*152-0185-00			Silicon	Replaceable by 1N4152	
D12	*152-0185-00			Silicon	Replaceable by 1N4152	
D14	*152-0185-00			Silicon	Replaceable by 1N4152	
D18	*152-0185-00			Silicon	Replaceable by 1N4152	
D21	*152-0185-00			Silicon	Replaceable by 1N4152	
D22	*152-0185-00			Silicon	Replaceable by 1N4152	
D24	*152-0185-00			Silicon	Replaceable by 1N4152	
D28	*152-0185-00			Silicon	Replaceable by 1N4152	
				Transistors		
Q11	*151-0190-01			Silicon	Tek Spec	
Q12	*151-0190-01			Silicon	Tek Spec	
Q14	*151-0190-01			Silicon	Tek Spec	
Q18	*151-0190-01			Silicon	Tek Spec	
Q21	*151-0190-01			Silicon	Tek Spec	
Q22	*151-0190-01			Silicon	Tek Spec	
Q24	*151-0190-01			Silicon	Tek Spec	
Q27	*151-0260-00			Silicon	Replaceable by 2N5189	
Q28	*151-0190-01			Silicon	Tek Spec	
				Resistors		
R27	315-0131-00			130 Ω	1/4 W	5%
R61	315-0751-00			750 Ω	1/4 W	5%
R62	315-0751-00			750 Ω	1/4 W	5%
R64	315-0751-00			750 Ω	1/4 W	5%
R68	315-0751-00			750 Ω	1/4 W	5%
R71	315-0751-00			750 Ω	1/4 W	5%
R72	315-0751-00			750 Ω	1/4 W	5%
R74	315-0751-00			750 Ω	1/4 W	5%
R78	315-0751-00			750 Ω	1/4 W	5%

MECHANICAL PARTS LIST

Tektronix Part No.	Serial/Model No. Eff	Disc	Qty 1 2 3 4 5	Description
670-0274-00			1	ASSEMBLY, circuit card--STANDARD assembly includes:
388-0920-00			1	BOARD, circuit
136-0220-00			8	SOCKET, transistor, 3 pin, square
136-0183-00			1	SOCKET, transistor, 3 pin, "D" shaped
131-0566-00			15	LINK, terminal connecting

RESISTANCE PROGRAM BOARD

ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
	*670-0273-01			Complete Board	
				Capacitors	
Tolerance ±20% unless otherwise indicated.					
C160	290-0263-00			2.7 µF	Elect. 15 V
C163	290-0263-00			2.7 µF	Elect. 15 V
C165	290-0263-00			2.7 µF	Elect. 15 V
C166	290-0263-00			2.7 µF	Elect. 15 V
C180	290-0263-00			2.7 µF	Elect. 15 V
C183	290-0263-00			2.7 µF	Elect. 15 V
C185	290-0263-00			2.7 µF	Elect. 15 V
C186	290-0263-00			2.7 µF	Elect. 15 V
				Relays	
K111	148-0039-00			Resonant Reed	
K112	148-0039-00			Resonant Reed	
K114	148-0039-00			Resonant Reed	
K118	148-0039-00			Resonant Reed	
K121	148-0039-00			Resonant Reed	
K122	148-0039-00			Resonant Reed	
K124	148-0039-00			Resonant Reed	
K128	148-0039-00			Resonant Reed	
				Transistors	
Q111	*151-0190-01			Silicon	Tek Spec
Q112	*151-0190-01			Silicon	Tek Spec
Q114	*151-0190-01			Silicon	Tek Spec
Q118	*151-0190-01			Silicon	Tek Spec
Q121	*151-0190-01			Silicon	Tek Spec
Q122	*151-0190-01			Silicon	Tek Spec
Q124	*151-0190-01			Silicon	Tek Spec
Q128	*151-0190-01			Silicon	Tek Spec
Q187	*151-0190-01			Silicon	Tek Spec
				Resistors	
R150	315-0272-00			2.7 kΩ	1/4 W 5%
R153	315-0272-00			2.7 kΩ	1/4 W 5%
R155	315-0272-00			2.7 kΩ	1/4 W 5%
R156	315-0272-00			2.7 kΩ	1/4 W 5%
R160	315-0151-00			150 Ω	1/4 W 5%
R163	315-0151-00			150 Ω	1/4 W 5%
R165	315-0151-00			150 Ω	1/4 W 5%
R166	315-0151-00			150 Ω	1/4 W 5%
R170	315-0272-00			2.7 kΩ	1/4 W 5%
R173	315-0272-00			2.7 kΩ	1/4 W 5%

R175	315-0272-00	2.7 kΩ	1/4 W	5%
R176	315-0272-00	2.7 kΩ	1/4 W	5%
R180	315-0151-00	150 Ω	1/4 W	5%
R183	315-0151-00	150 Ω	1/4 W	5%
R185	315-0151-00	150 Ω	1/4 W	5%
R186	315-0151-00	150 Ω	1/4 W	5%
R361	315-0161-00	160 Ω	1/4 W	5%
R362	315-0161-00	160 Ω	1/4 W	5%
R364	315-0161-00	160 Ω	1/4 W	5%
R368	315-0161-00	160 Ω	1/4 W	5%
R371	315-0161-00	160 Ω	1/4 W	5%
R372	315-0161-00	160 Ω	1/4 W	5%
R374	315-0161-00	160 Ω	1/4 W	5%
R378	315-0161-00	160 Ω	1/4 W	5%
R387	315-0102-00	1 kΩ	1/4 W	5%

Integrated Circuits

U112	156-0011-00	Dual 2-Input NAND/ NOR Gate	Replaceable by Fairchild μL914
U118	156-0011-00	Dual 2-Input NAND/ NOR Gate	Replaceable by Fairchild μL914
U122	156-0011-00	Dual 2-Input NAND/ NOR Gate	Replaceable by Fairchild μL914
U128	156-0011-00	Dual 2-Input NAND/ NOR Gate	Replaceable by Fairchild μL914

MECHANICAL PARTS LIST

Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
670-0273-01			1		ASSEMBLY, circuit card--RESISTANCE
- - - - - -			-		assembly includes:
388-0919-01			1		BOARD, circuit
136-0220-00			9		SOCKET, transistor, 3 pin, square
136-0237-00			4		SOCKET, transistor, 3 pin, "D" shape
131-0639-00			48		CONTACT, electrical
131-0566-00			15		LINK, terminal connecting

CONDUCTANCE PROGRAM BOARD

ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
	*670-0272-01			Complete Board		
				Capacitors		
C260	290-0177-00			1 µF	Elect. 50 V	20%
C263	290-0177-00			1 µF	Elect. 50 V	20%
C265	290-0177-00			1 µF	Elect. 50 V	20%
C266	290-0177-00			1 µF	Elect. 50 V	20%
C280	290-0177-00			1 µF	Elect. 50 V	20%
C283	290-0177-00			1 µF	Elect. 50 V	20%
C285	290-0177-00			1 µF	Elect. 50 V	20%
C286	290-0177-00			1 µF	Elect. 50 V	20%
				Diodes		
D211	*152-0185-00			Silicon	Replaceable by 1N4152	
D212	*152-0185-00			Silicon	Replaceable by 1N4152	
D214	*152-0185-00			Silicon	Replaceable by 1N4152	
D218	*152-0185-00			Silicon	Replaceable by 1N4152	
D221	*152-0185-00			Silicon	Replaceable by 1N4152	
D222	*152-0185-00			Silicon	Replaceable by 1N4152	
D224	*152-0185-00			Silicon	Replaceable by 1N4152	
D228	*152-0185-00			Silicon	Replaceable by 1N4152	
				Relays		
K211	148-0039-00			Resonant Reed		
K212	148-0039-00			Resonant Reed		
K214	148-0039-00			Resonant Reed		
K218	148-0039-00			Resonant Reed		
K221	148-0039-00			Resonant Reed		
K222	148-0039-00			Resonant Reed		
K224	148-0039-00			Resonant Reed		
K228	148-0039-00			Resonant Reed		
				Transistors		
Q211	*151-0190-01			Silicon	Tek Spec	
Q212	*151-0190-01			Silicon	Tek Spec	
Q214	*151-0190-01			Silicon	Tek Spec	
Q218	*151-0190-01			Silicon	Tek Spec	
Q221	*151-0190-01			Silicon	Tek Spec	
Q222	*151-0190-01			Silicon	Tek Spec	
Q224	*151-0190-01			Silicon	Tek Spec	
Q228	*151-0190-01			Silicon	Tek Spec	
Q287	*151-0206-00			Silicon	Replaceable by 2N5189	
				Resistors		
R260	315-0121-00			120 Ω	1/4 W	5%
R261	315-0301-00			300 Ω	1/4 W	5%
R262	315-0301-00			300 Ω	1/4 W	5%
R263	315-0121-00			120 Ω	1/4 W	5%
R264	315-0301-00			300 Ω	1/4 W	5%
R265	315-0121-00			120 Ω	1/4 W	5%
R266	315-0121-00			120 Ω	1/4 W	5%

R268	315-0301-00	300 Ω	1/4 W	5%
R271	315-0301-00	300 Ω	1/4 W	5%
R272	315-0301-00	300 Ω	1/4 W	5%
R274	315-0301-00	300 Ω	1/4 W	5%
R278	315-0301-00	300 Ω	1/4 W	5%
R280	315-0121-00	120 Ω	1/4 W	5%
R283	315-0121-00	120 Ω	1/4 W	5%
R285	315-0121-00	120 Ω	1/4 W	5%
R286	315-0121-00	120 Ω	1/4 W	5%
R287	315-0131-00	130 Ω	1/4 W	5%

MECHANICAL PARTS LIST

Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
670-0272-01			1		ASSEMBLY, circuit card--CONDUCTANCE
- - - - - -			-		assembly includes:
388-0918-01			1		BOARD, circuit
136-0220-00			8		SOCKET, transistor, 3 pin, square
136-0183-00			1		SOCKET, transistor, 3 pin, "D" shape
131-0639-00			48		CONTACT, electrical
131-0566-00			15		LINK, terminal connecting

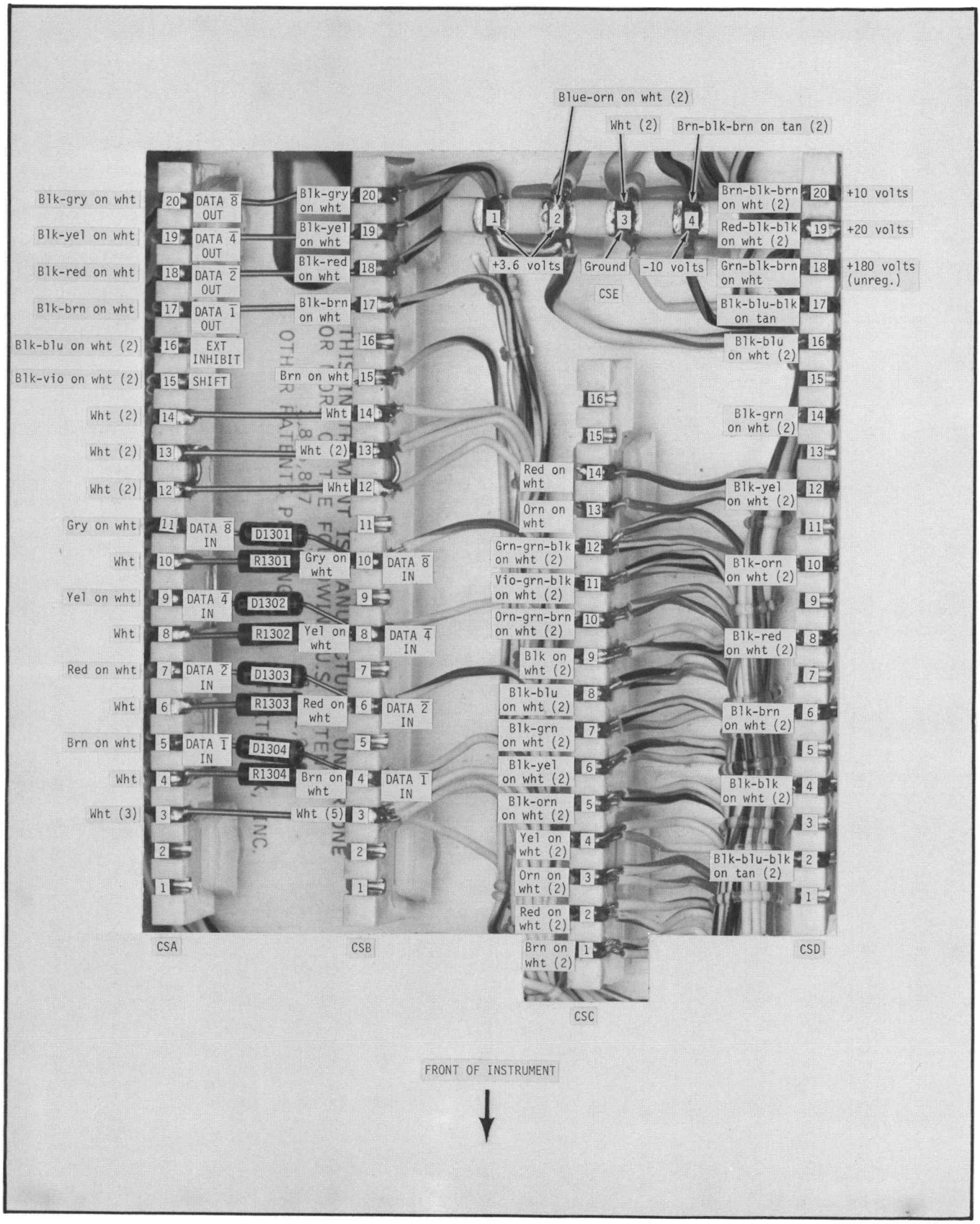


Fig. 3-8. Identification and wiring color codes on tie strips. (Top view.)

J112

		J1	J13	TIE STRIP (CSA)	TIE STRIP (CSB)	
1	GND			4		
2	GND			6		
3	GND			8		
4	GND			10		
5	GND			12	12	
6	GND			12	12	
7	GND			13	13	
8	GND			13	13	
9	GND			14	14	
10	GND			14	14	
11						
12						
13						
14						
15						
16						
17						
18						
19	DATA $\bar{8}$ IN			11		
20	DATA $\bar{4}$ IN			9		
21	DATA $\bar{2}$ IN			7		
22	DATA $\bar{1}$ IN			5		
23	SHIFT		10	15		
24	EXTERNAL INHIBIT		12	16		
25	DATA $\bar{1}$ OUT	21		17	17	
26	DATA $\bar{2}$ OUT	17		18	18	
27	DATA $\bar{4}$ OUT	7		19	19	
28	DATA $\bar{8}$ OUT	3		20	20	
29						
30						
31						
32						
33						
34						
35						
36						

J206

	J13	TIE STRIP (CSD)	TIE STRIP (CSE)			
1						
2						
3						
4						
5						
6						
7						
8						
9						
10	M					
11	N					
12	P					
13	R					
14	S					
15	T					
16	U					
17						
18						
19	GND		2			
20	GND		2			
21	GND		2			
22	GND		2			
23	GND		2			
24	GND		2			
25	GND		2			
26	GND		2			
27	GND		2			
28	GND		2			
29		20				
30		20				
31			4			
32			4			
33		19				
34		19				
35	+3.6V		1			
36	+3.6V		1			

J231

	J1	J2	TIE STRIP (CSC)	TIE STRIP (CSB)		
1	F		1			
2	H		2			
3	J		3			
4	K		4			
5	L					
6	M					
7	N					
8	P					
9	T					
10	U					
11	V					
12	W					
13	X	B	5			
14	Y	C	6			
15	Z	D	7			
16	AA	E	8			
17	8					
18	22					
19	BB	F	9			
20	CC	H	10			
21	DD	J	11			
22	EE	K	12			
23		L				
24		M				
25		N				
26		P				
27				15		
28			14			
29			13			
30	E					
31	D					
32	C					
33	B					
34						
35		8				
36				3		

Ⓐ

J232

	J2	J3	J4				
1	T						
2	U						
3	V						
4	W						
5	X	B					
6	Y	C					
7	Z	D					
8	AA	E					
9	BB	F					
10	CC	H					
11	DD	J					
12	EE	K					
13		L					
14		M					
15		N					
16		P					
17	22						
18		8					
19		T					
20		U					
21		V					
22		W					
23		X	B				
24		Y	C				
25		Z	D				
26		AA	E				
27							
28							
29							
30							
31							
32							
33							
34							
35		22					
36							

J233

	J3	J4	J5	J6			
1	BB	F					
2	CC	H					
3	DD	J					
4	EE	K					
5		L					
6		M					
7		N					
8		P					
9		T					
10		U					
11		V					
12		W					
13		X	B				
14		Y	C				
15		Z	D				
16		AA	E				
17		8					
18		22					
19		BB	F				
20		CC	H				
21		DD	J				
22		EE	K				
23			L				
24			M				
25			N				
26			P				
27			T				
28			U				
29			V				
30			W				
31			X	B			
32			Y	C			
33			Z	D			
34			AA	E			
35			8				
36			22				

J234

	J5	J6	J7	J8			
1	BB	F					
2	CC	H					
3	DD	J					
4	EE	K					
5		L					
6		M					
7		N					
8		P					
9		T					
10		U					
11		V					
12		W					
13		X	B				
14		Y	C				
15		Z	D				
16		AA	E				
17		8					
18		22					
19		BB	F				
20		CC	H				
21		DD	J				
22		EE	K				
23			L				
24			M				
25			N				
26			P				
27			T				
28			U				
29			V				
30			W				
31			X	B			
32			Y	C			
33			Z	D			
34			AA	E			
35			8				
36			22				

J235

	J7	J8	J9	J10			
1	BB	F					
2	CC	H					
3	DD	J					
4	EE	K					
5		L					
6		M					
7		N					
8		P					
9		T					
10		U					
11		V					
12		W					
13		X	B				
14		Y	C				
15		Z	D				
16		AA	E				
17		8					
18		22					
19		BB	F				
20		CC	H				
21		DD	J				
22		EE	K				
23			L				
24			M				
25			N				
26			P				
27			T				
28			U				
29			V				
30			W				
31			X	B			
32			Y	C			
33			Z	D			
34			AA	E			
35			8				
36			22				

J236

	J9	J10	J11	J12			
1	BB	F					
2	CC	H					
3	DD	J					
4	EE	K					
5		L					
6		M					
7		N					
8		P					
9		T					
10		U					
11		V					
12		W					
13		X	B				
14		Y	C				
15		Z	D				
16		AA	E				
17		8					
18		22					
19		BB	F				
20		CC	H				
21		DD	J				
22		EE	K				
23			L				
24			M				
25			N				
26			P				
27			T				
28			U				
29			V				
30			W				
31			X	B			
32			Y	C			
33			Z	D			
34			AA	E			
35			8				
36			22				

J237

	J11	J12	TIE STRIP (CSD)				
1	BB	F					
2	CC	H					
3	DD	J					
4	EE	K					
5		L					
6		M					
7		N					
8		P					
9		T	2				
10		U	4				
11		V	6				
12		W	8				
13		X	10				
14		Y	12				
15		Z	14				
16		AA	16				
17		8					
18		22					
19							
20							
21							
22							
23							
24							
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36							

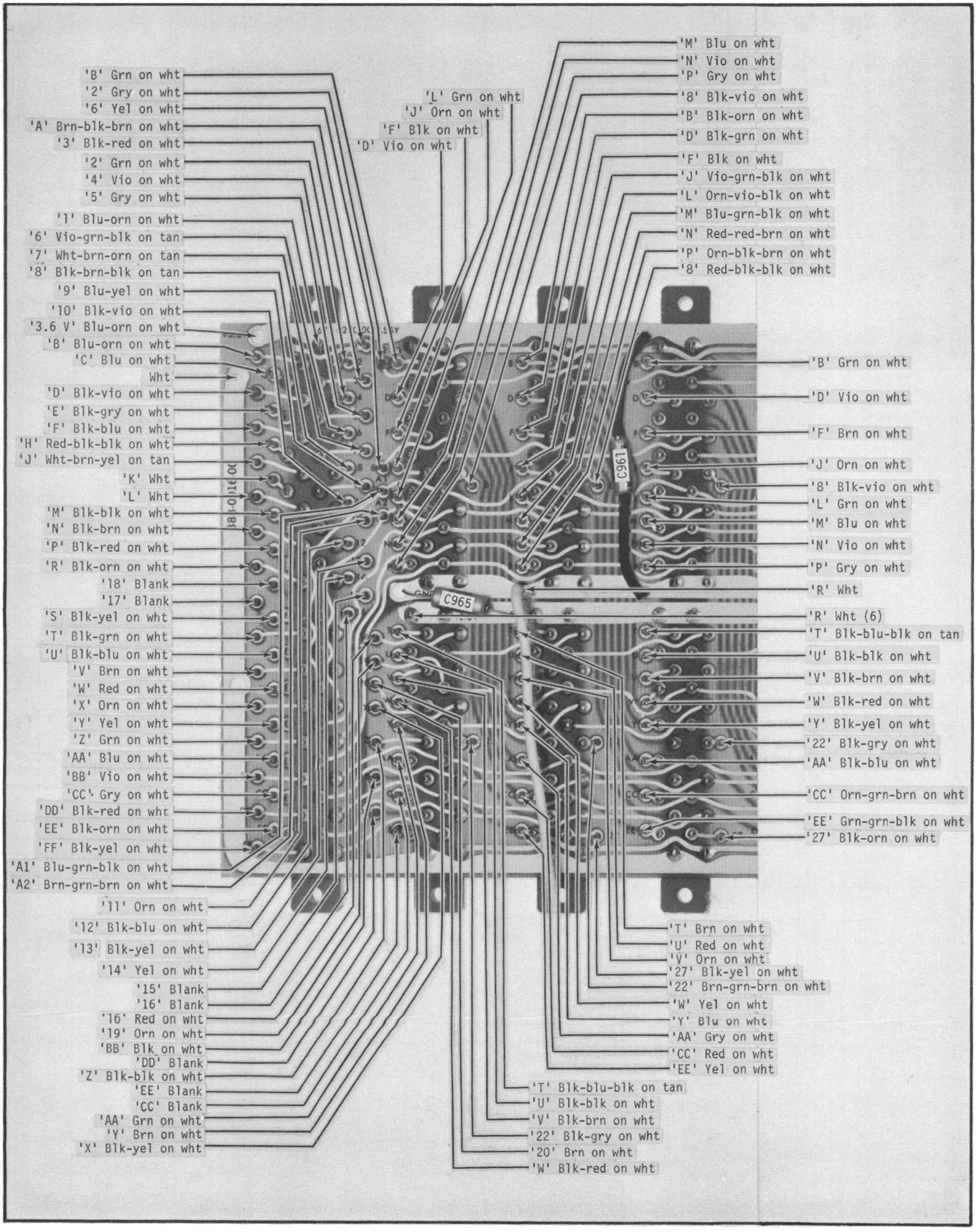


Fig. 3-9. Partial interconnector circuit board showing component location and wiring color codes.

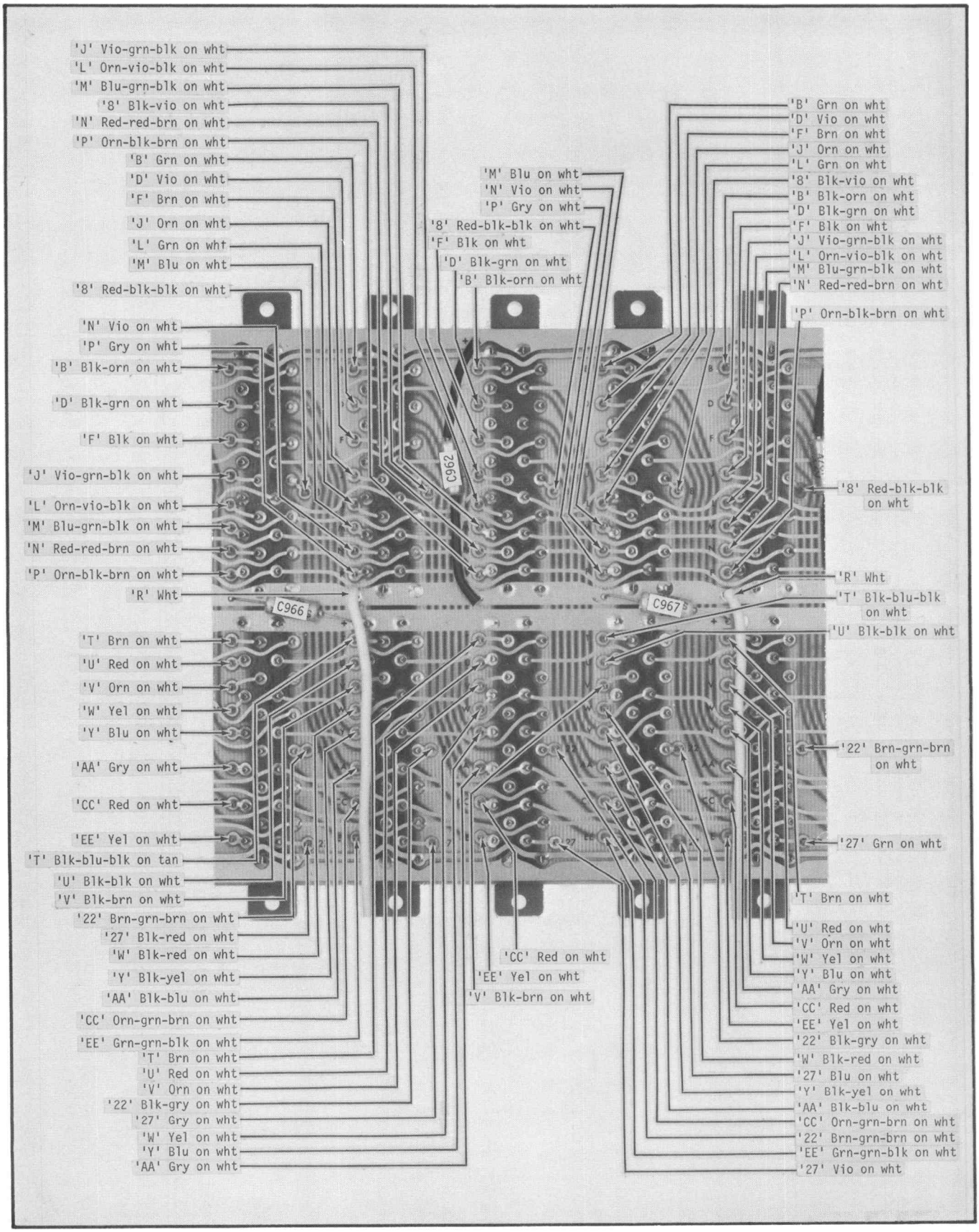


Fig. 3-10. Partial interconnector circuit board showing component location and wiring color codes.

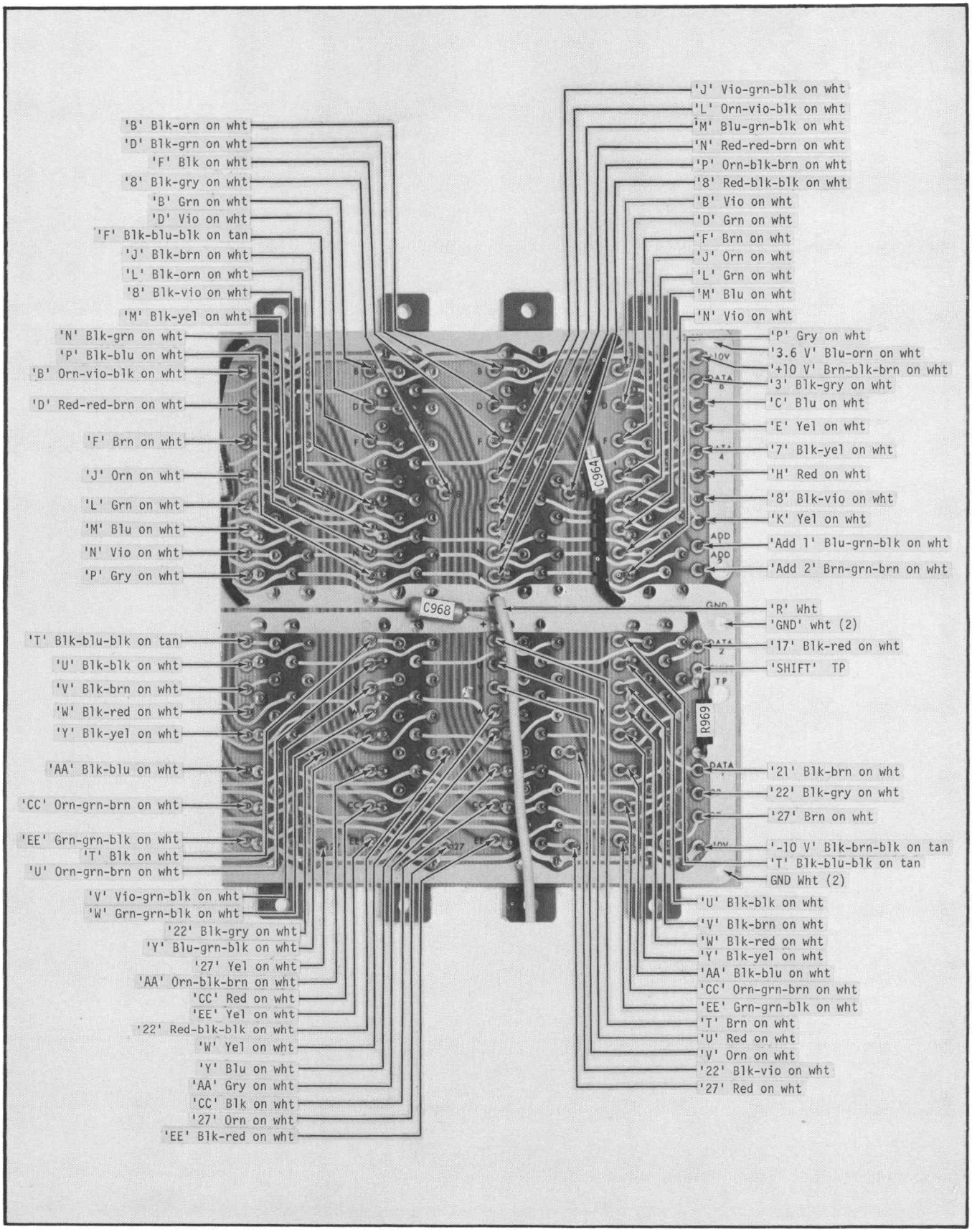


Fig. 3-11. Partial interconnector circuit board showing component location and wiring color codes.

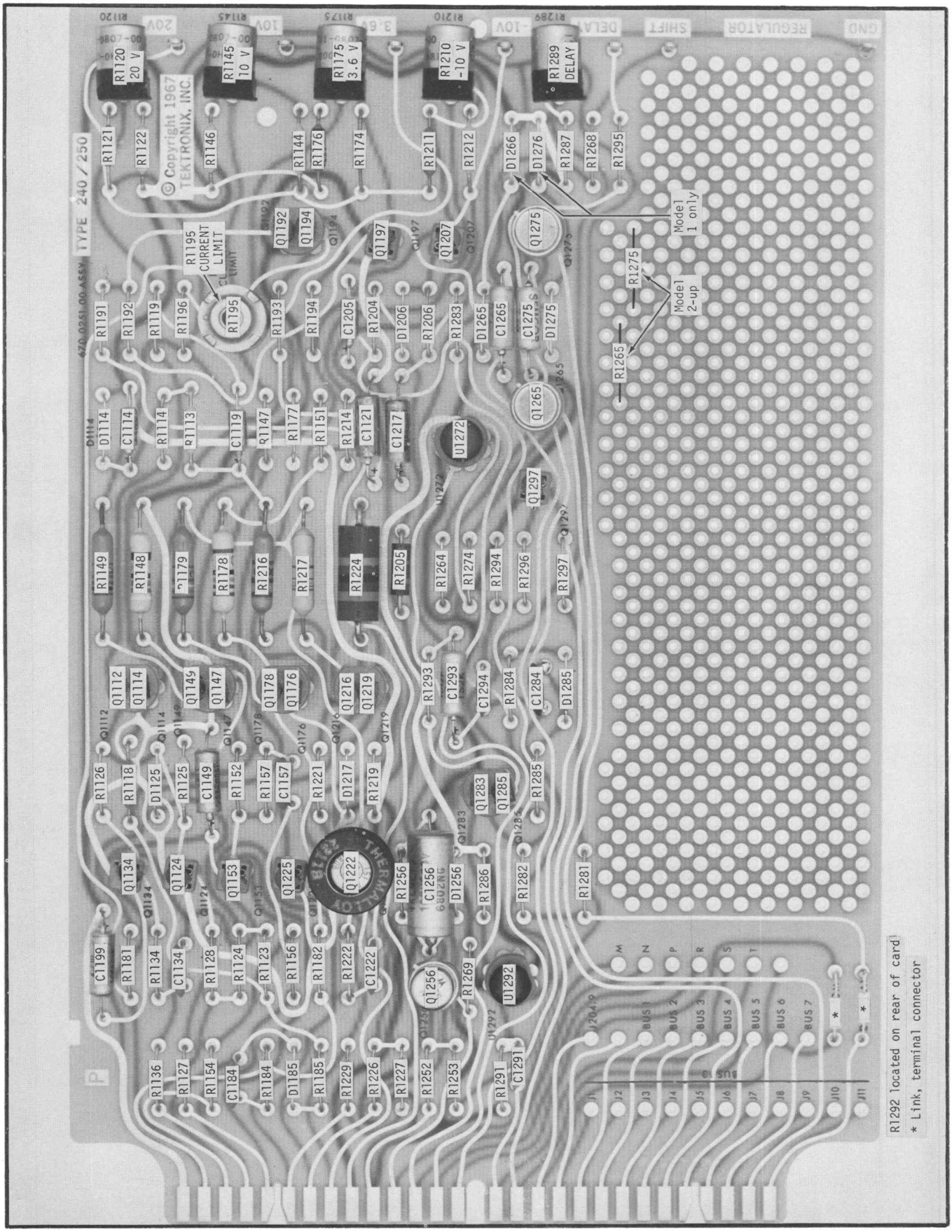


Fig. 3-12. P13 Regulator circuit card showing component locations.

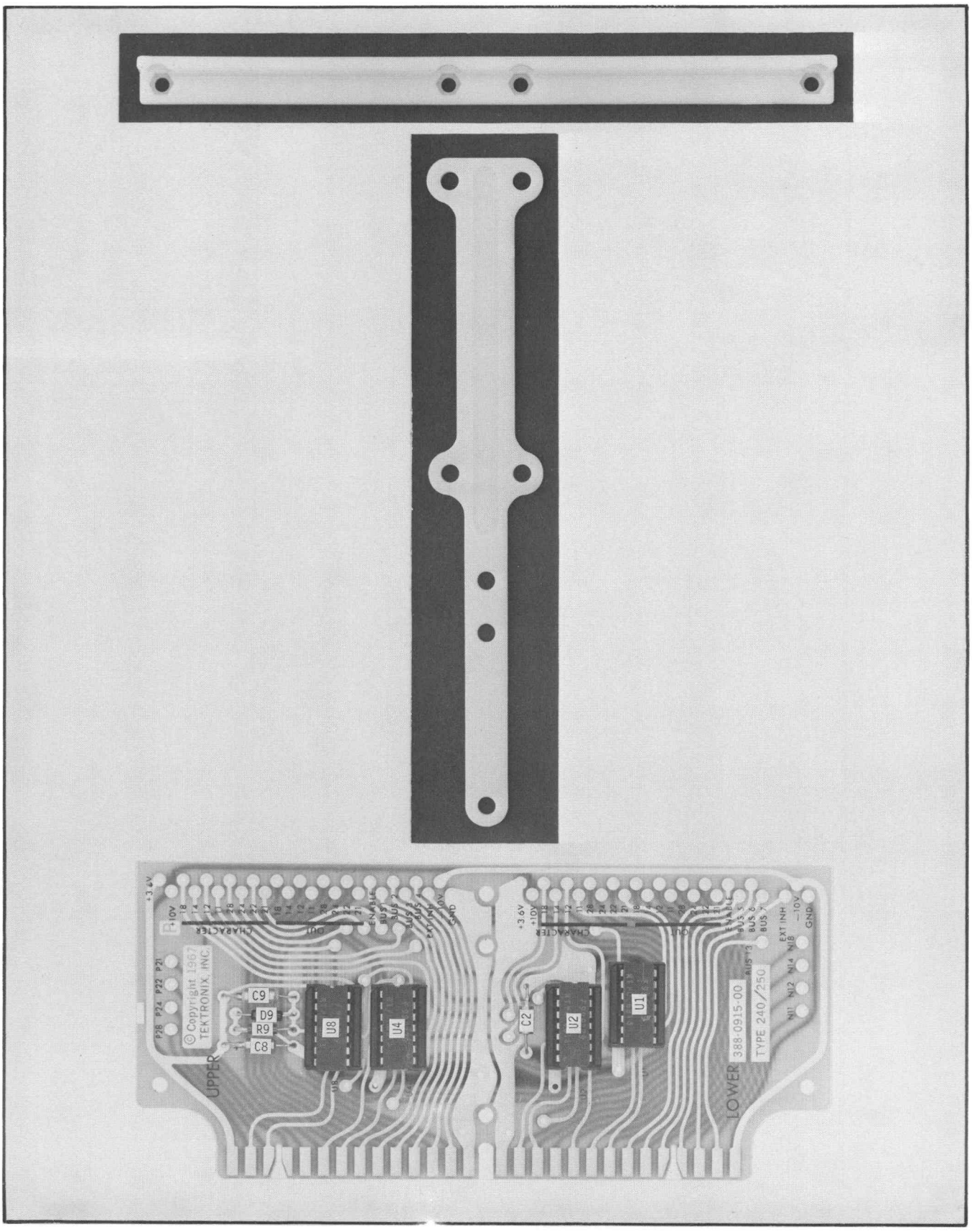


Fig. 3-13. Shift Register circuit card and accompanying parts.

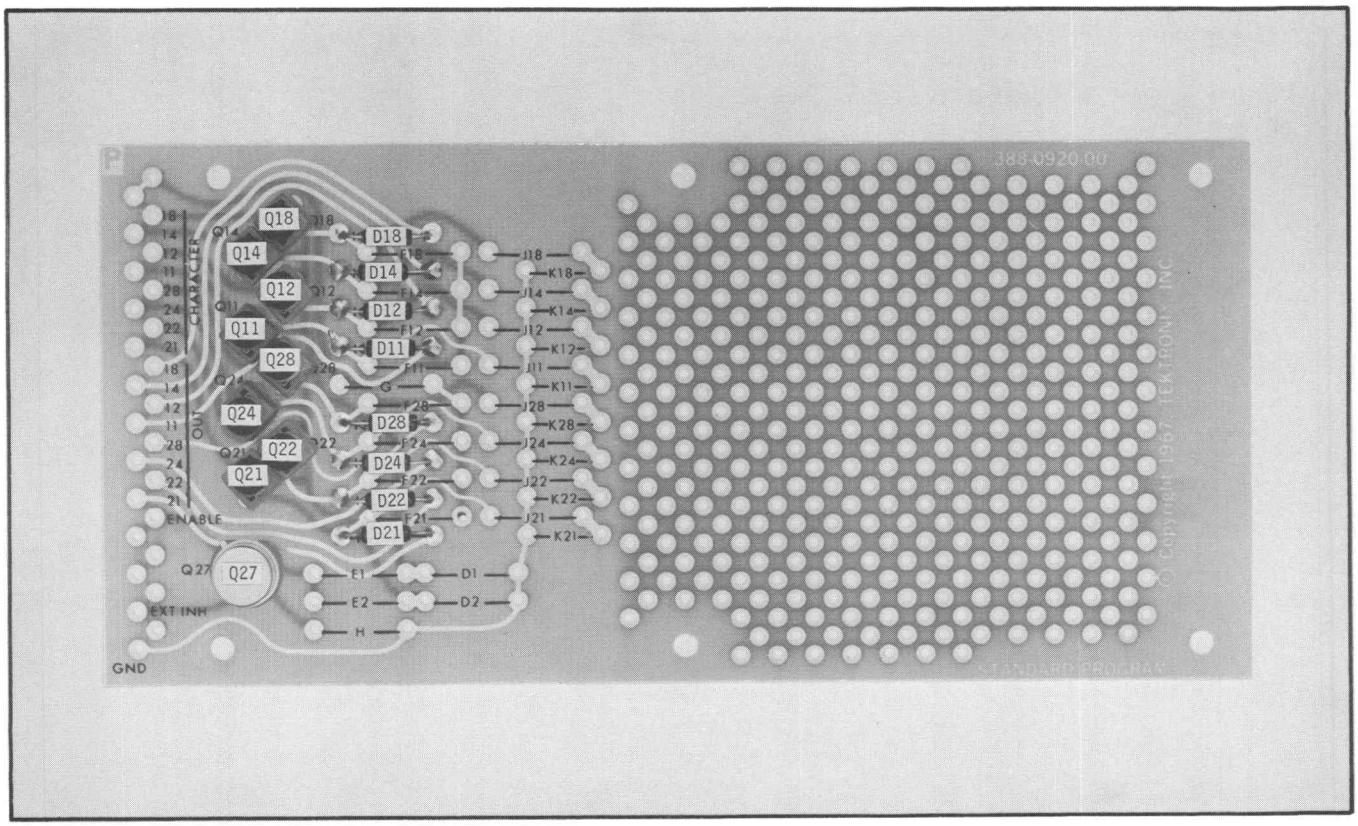


Fig. 3-14. Standard program board.

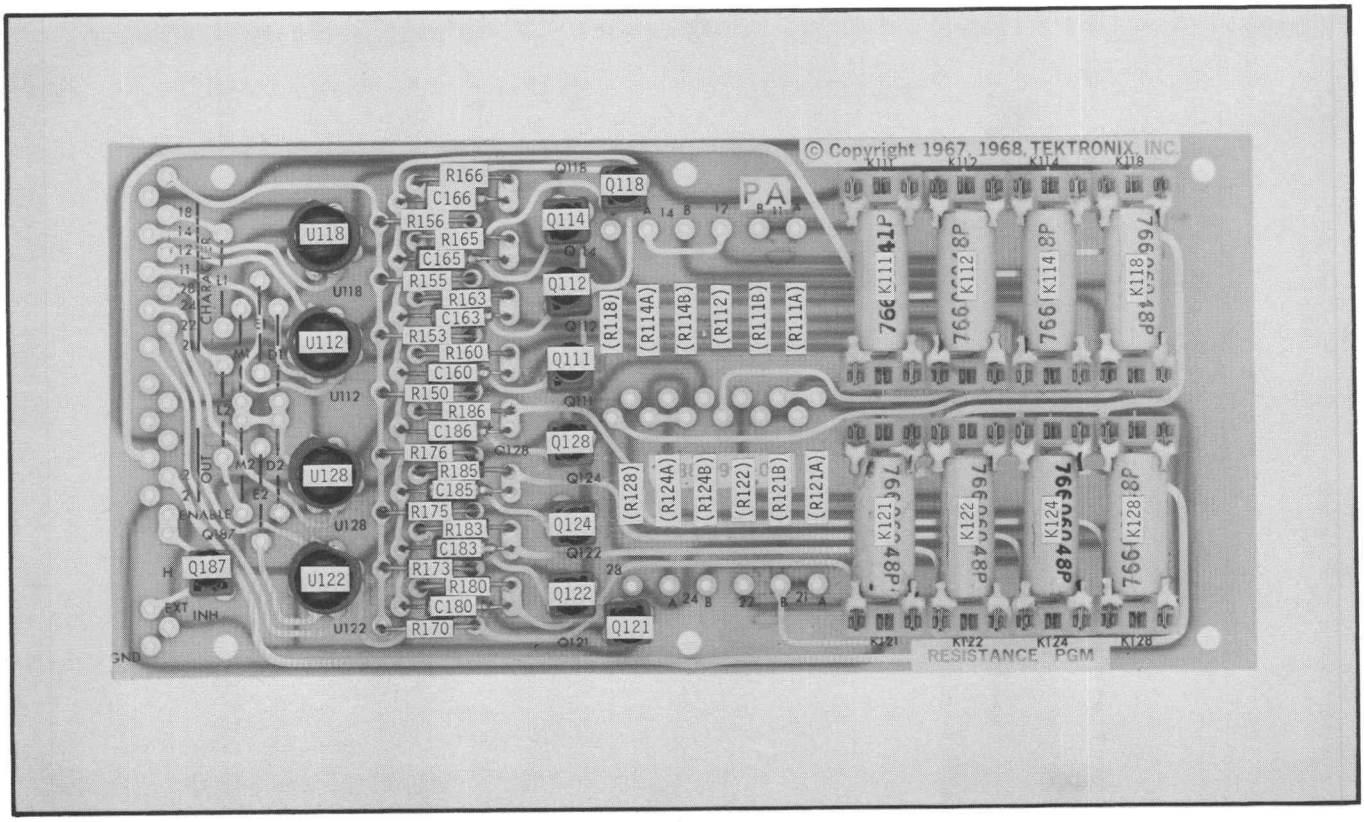


Fig. 3-15. Resistance program board.

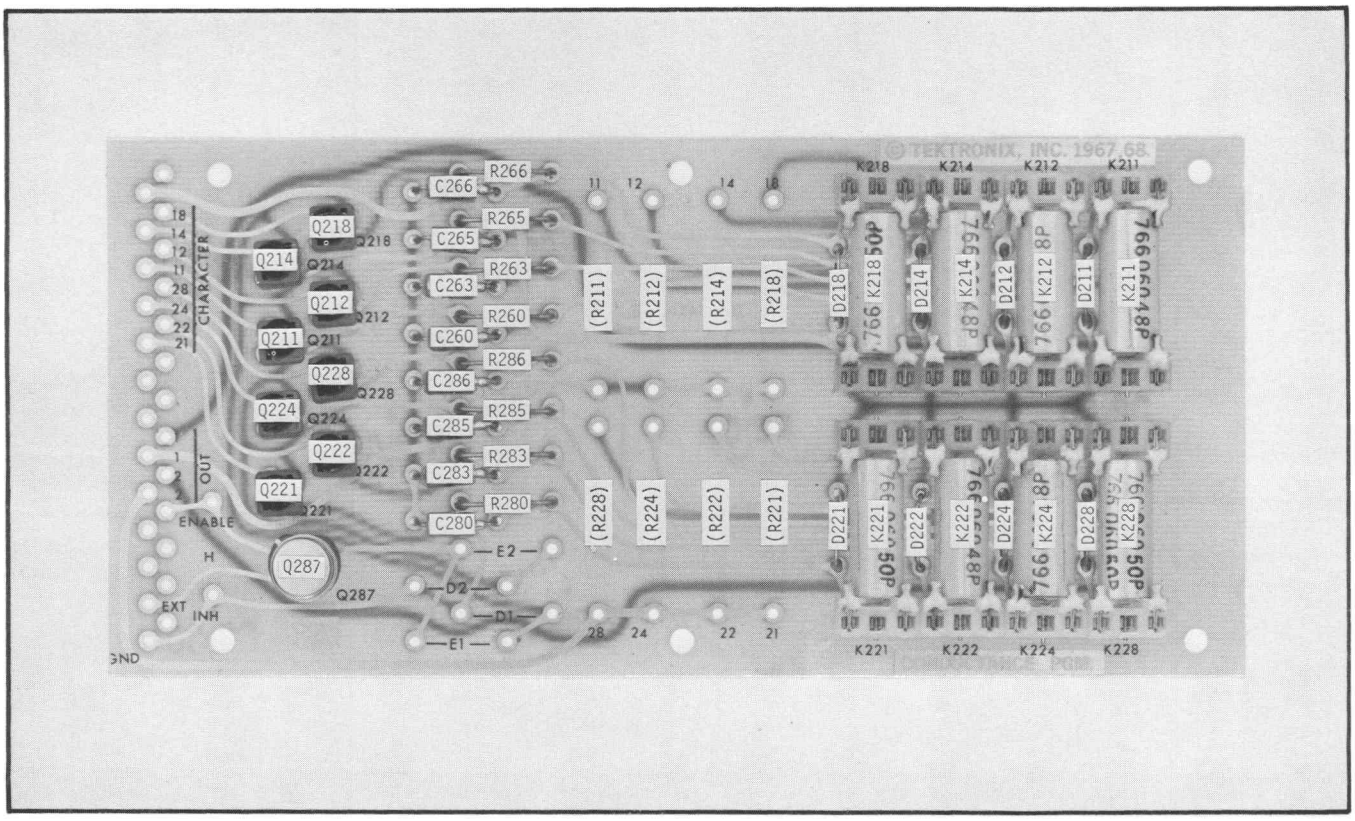


Fig. 3-16. Conductance program board

SECTION 4
CALIBRATION

Change information, if any, affecting this section will be found at the rear of this manual.

CALIBRATION PROCEDURE

Introduction

A complete procedure for calibration of the Type R250 is given in the following pages. Doing the whole procedure in sequence returns the instrument to the original performance standards. Limits and tolerances in this procedure are given as calibration guides and are not instrument specifications. An abridged calibration procedure is included in this section. This procedure can be used as a check-list by experienced operators.

Calibration of the Type R250 should be checked after each 1000 hours of operation, or at least once every 6 months to assure that the instrument is operating correctly and accurately. Recalibration of the instrument may be performed periodically as part of a regular maintenance schedule, or may be done whenever the need is indicated by improper performance. Portions of the instrument may require recalibration if components have been replaced or other electrical repairs have been made in the circuitry.

Any required maintenance should be performed before recalibration. Trouble observed during calibration should be corrected using the techniques discussed in Section 3.

Test Equipment Required

The following test equipment or its equivalent is required for complete calibration of the Type R250 (see Fig. 4-1). Specifications given are the minimum necessary for accurate calibration of this instrument. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications given for the recommended equipment.

1. Variable Autotransformer. Must be capable of supplying 280 volt-amperes over a range of 90 to 136 volts (180 to 272 volts for 230-volt nominal line). If the autotransformer is not equipped with an output voltmeter, monitor the output with an AC voltmeter having a full-scale reading of at least 136 volts RMS (115-volt operation) or 272 volts RMS (230-volt operation). Suggested equipment: General Radio W10MT3A Variac Autotransformer (115-volt operation) or General Radio W20HMT3A Variac Autotransformer (230-volt operation).

2. Precision DC Voltmeter. Accuracy, within ±0.1%; meter resolution, 36 millivolts or less; range, zero to 20 volts. Recommended equipment: Fluke Model 825A Differential DC Voltmeter.

3. Test Oscilloscope. Bandwidth, DC to 500 kHz; minimum deflection factor, five millivolts/division; accuracy, within 3%. Tektronix Type 453 recommended.

4. 1X probe with BNC connector. Tektronix P6011 Probe recommended.

5. DC ammeter. Range, zero to 10 amperes; accuracy, 3%. Total resistance including test leads: less than 0.1 ohm. Triplett Model 630-NA recommended.

6. Front and Rear Extender Card. Tektronix Part Number 670-0240-00 and 670-0241-00. These cards are standard accessories with the Type 230.

7. Adjustment tool: Insulated screwdriver, 1½ inch shaft, non-metallic. Tektronix Part Number 003-0000-00.

Abridged Calibration Procedure

This procedure is provided as a calibration guide to the experienced calibrator and as a record of calibration. It may be duplicated from the manual for those purposes. Since the step numbers and titles used here correspond to those used in the complete procedure, this procedure is also an index for the main procedure. The performance requirements listed below are identical to those in the complete procedure.

Type R250, Serial No. _____

Calibration Date _____

Calibrated by _____

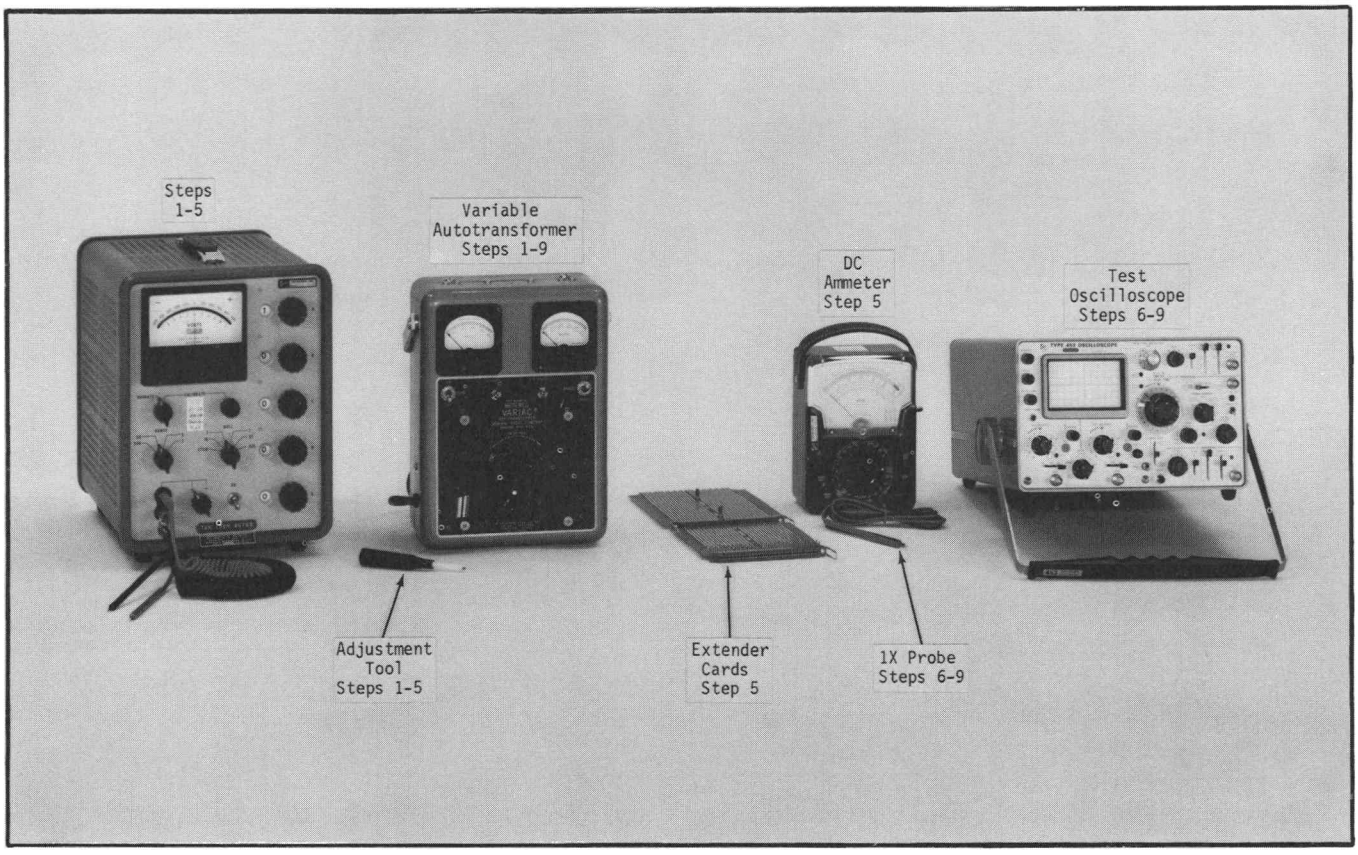


Fig. 4-1. Test equipment required for steps 1–9.

- ☐ 1. Adjust +20-Volt Regulator (R1120) (Page 4-3)
  +20 volts, ±0.2 volt. Meter Reading _____
- ☐ 2. Adjust +10-Volt Regulator (R1145) (Page 4-3)
  +10 volts, ±0.1 volt. Meter Reading _____
- ☐ 3. Adjust -10-Volt Regulator (R1210) (Page 4-3)
  -10 volts, ±0.1 volt. Meter Reading _____
- ☐ 4. Adjust +3.6-Volt Regulator (R1175)(Page 4-3)
  +3.6 volts, ±0.036 volt. Meter Reading ____
- ☐ 5. Adjust Current Limit (R1195) (Page 4-3)
  6.2 amperes, ±0.62 ampere. Meter Reading __
- ☐ 6. Check +20-Volt Ripple (Page 4-4)
  40 millivolts peak-to-peak maximum ripple.
  Amplitude _____
- ☐ 7. Check +10-Volt Ripple (Page 4-4)
  15 millivolts peak-to-peak maximum ripple.
  Amplitude _____
- ☐ 8. Check -10-Volt Ripple (Page 4-4)
  100 millivolts peak-to-peak maximum ripple.
  Amplitude _____
- ☐ 9. Check +3.6-Volt Ripple (Page 4-5)
  8 millivolts peak-to-peak maximum ripple.
  Amplitude ____

CALIBRATION PROCEDURE

General

The following procedure is arranged in a sequence which allows the Type R250 to be calibrated with the least interaction of adjustments and reconnection of equipment. The symbol ◐ is used to identify each step in which an adjustment is made. When a step interacts with others, the steps which need to be checked are noted in the "INTERACTION..." step. When performing a partial calibration, adjust the controls which have interaction only if the listed tolerance is not met. Best overall performance is provided if each adjustment is made to the exact setting, even if the "CHECK..." step indicates that instrument operation is within the stated tolerance.

The procedure uses the equipment listed under Test Equipment Required. The equipment is shown in Fig. 4-1 at the beginning of the procedure. If substitute equipment is used, control settings or test equipment connections may need to be altered to meet the requirements of the equipment used.

NOTE

All waveforms shown in this procedure are actual waveform photographs taken with a Tektronix Oscilloscope Camera System.

Preliminary Procedure

1. Disconnect all cables from the Type R250 rear panel.

2. If the instrument is rackmounted, extend it to the full length of the rails.

3. Remove the top cover from the instrument.

4. Connect the autotransformer and other test equipment to a suitable power source.

5. Connect the Type R250 to the autotransformer output.

6. Turn on the Type R250 and the test equipment. Allow at least 5 minutes warmup for the Type R250 at 25°C ±5°C before checking the instrument to the listed tolerances.

7. Set the autotransformer output to the center voltage of the range selected by the Line Voltage Selector assembly on the rear panel of the Type R250.

8. Unscrew the door fasteners and open the front panel of the Type R250.

Calibration

1. Adjust +20-Volt Regulator

a. The test equipment setup is shown in Fig. 4-1.

b. Connect the precision DC voltmeter from the 20 V test point to the GND test point on the regulator circuit card (see Fig. 4-2).

c. CHECK--Meter reading: +20 volts, ±0.2 volt.

d. ADJUST--R1120 for +20 volts.

e. INTERACTION--May affect the other regulator circuits.

2. Adjust +10-Volt Regulator

a. Connect the precision DC voltmeter from the 10 V test point to the GND test point (see Fig. 4-2).

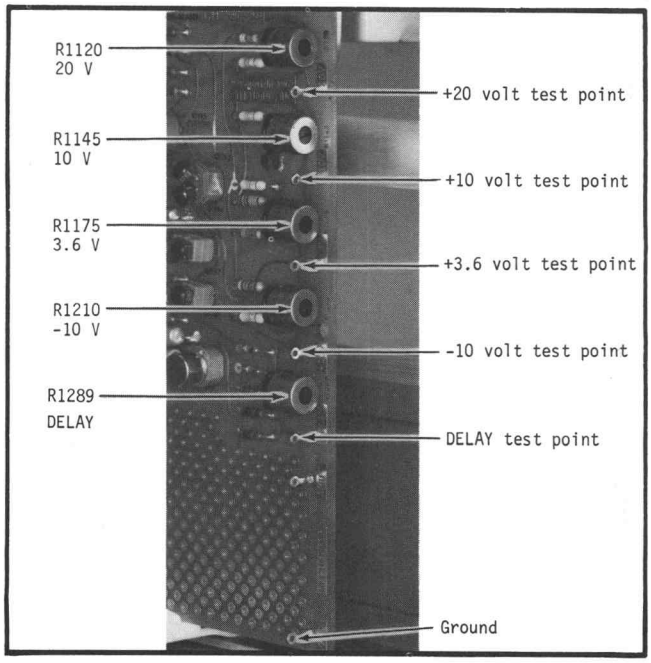


Fig. 4-2. Regulator circuit card showing voltage test points and adjustments. (DELAY is not used in the Type R250.)

b. CHECK--Meter reading: +10 volts, ±0.1 volt.

c. ADJUST--R1145 for +10 volts.

3. Adjust -10-Volt Regulator

a. Connect the precision DC voltmeter from the -10 V test point to the GND test point (see Fig. 4-2).

b. CHECK--Meter reading: -10 volts, ±0.1 volt.

c. ADJUST--R1210 for -10 volts.

4. Adjust +3.6-Volt Regulator

a. Connect the precision DC voltmeter from the 3.6 V test point to the GND test point (see Fig. 4-2).

b. CHECK--Meter reading: +3.6 volts, ±0.036 volts.

c. ADJUST--R1175 for +3.6 volts.

5. Adjust +3.6-Volt Current Limiter

a. Set the Type R250 Power switch to Off.

b. Remove the regulator circuit card from the Type R250.

c. Assemble the extender card and insert it into J13 of the Type R250.

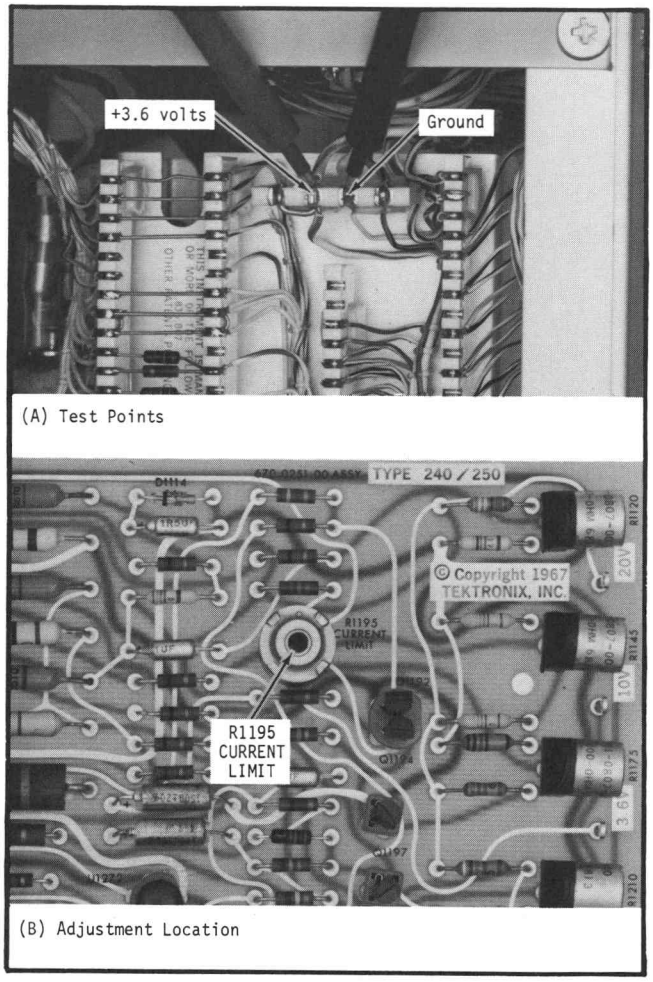


Fig. 4-3. Current Limit Adjustment.

d. Insert the regulator card into the extender jack. Ensure that no electrical contact exists between the regulator card and metallic parts on the front panel assembly. If contact exists, place some insulating material between the card and the front panel assembly.

e. Set the Type R250 Power switch to On and adjust the autotransformer output to the upper limit of the range selected by the Line Voltage Selector.

f. Set the DC ammeter to the 12A scale.

g. Place the meter test probes between +3.6 volts and ground as illustrated in Fig. 4-3(A). Do not make this check at any other points in the instrument.

h. CHECK--Meter reading: 6.2 amperes, ±0.62 amperes.

i. ADJUST--R1195 for 6.2 amperes. (See Fig. 4-3B)

j. Set the Type R250 Power switch off and remove the regulator card and extender card assembly.

k. Re-insert the regulator card and set the Type R250 Power switch to On.

l. Return the autotransformer output voltage to midrange.

6. Check +20-Volt Ripple

a. Set the test oscilloscope deflection factor to 10 mV/div (AC coupled), and set the sweep rate to 5 ms/div (line trigger).

b. Connect the 1X probe from the vertical input of the test oscilloscope to the 20 V test point on the Type R250 (see Fig. 4-2). Connect the probe ground lead to the GND test point on the regulator card.

c. Adjust the test oscilloscope for a convenient display. A typical waveform is illustrated in Fig. 4-4.

d. CHECK--Test oscilloscope display for 4 divisions or less (40 millivolts or less) line-frequency ripple while varying the autotransformer output voltage through the regulating range selected with the Line Voltage Selector.

7. Check +10-Volt Ripple

a. Connect the 1X probe from the vertical input of the test oscilloscope to the 10 V test point on the regulator card.

b. Change the vertical deflection factor on the test oscilloscope to 5 mV/div.

c. CHECK--Test oscilloscope display for 3 divisions or less (15 millivolts or less) line-frequency ripple while varying the autotransformer output voltage through the regulating range.

8. Check -10-Volt Ripple

a. Change the deflection factor of the test oscilloscope to 20 mV/div.

b. Connect the 1X probe from the vertical input of the test oscilloscope to the -10 V test point on the regulator card.

c. CHECK--Test oscilloscope display for 5 divisions or less (100 millivolts or less) line-frequency ripple

while varying the autotransformer output voltage through the regulating range.

9. Check +3.6-Volt Ripple

a. Change the deflection factor of the test oscilloscope to 5 mV/div.

b. Connect the 1X probe from the vertical input of the test oscilloscope to the 3.6 V test point on the regulator card.

c. CHECK--Test oscilloscope display for 1.6 divisions or less (8 millivolts or less) line-frequency ripple while varying the autotransformer output voltage through the regulating range. Return the autotransformer output voltage to midrange.

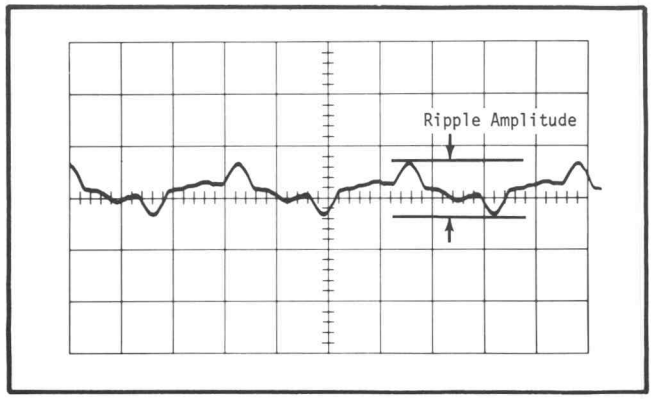


Fig. 4-4. Typical Ripple waveform.

d. Turn off the Type R250 and the test equipment, Disconnect the 1X probe from the test point, and close and secure the Type R250 front panel door assembly. The calibration procedure is completed.

NOTES

ABBREVIATIONS AND SYMBOLS

A or amp	amperes
AC or ac	alternating current
AF	audio frequency
α	alpha—common-base current amplification factor
AM	amplitude modulation
$\approx$	approximately equal to
β	beta—common-emitter current amplification factor
BHB	binding head brass
BHS	binding head steel
BNC	baby series "N" connector
$\times$	by or times
C	carbon
C	capacitance
cap.	capacitor
cer	ceramic
cm	centimeter
comp	composition
conn	connector
$\sim$	cycle
c/s or cps	cycles per second
CRT	cathode-ray tube
csk	countersunk
Δ	increment
dB	decibel
dBm	decibel referred to one milliwatt
DC or dc	direct current
DE	double end
$^\circ$	degrees
$^\circ$C	degrees Celsius (degrees centigrade)
$^\circ$F	degrees Fahrenheit
$^\circ$K	degrees Kelvin
dia	diameter
$\div$	divide by
div	division
EHF	extremely high frequency
elect.	electrolytic
EMC	electrolytic, metal cased
EMI	electromagnetic interference (see RFI)
EMT	electrolytic, metal tubular
ε	epsilon—2.71828 or % of error
$\geq$	equal to or greater than
$\leq$	equal to or less than
ext	external
F or f	farad
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
FM	frequency modulation
ft	feet or foot
G	giga or 10^9
g	acceleration due to gravity
Ge	germanium
GHz	gigahertz
GMV	guaranteed minimum value
GR	General Radio
$>$	greater than
H or h	henry
h	height or high
hex.	hexagonal
HF	high frequency
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
HV	high voltage
Hz	hertz (cycles per second)
ID	inside diameter
IF	intermediate frequency
in.	inch or inches
incd	incandescent
∞	infinity
int	internal
$\int$	integral
k	kilohms or kilo (10^3)
k Ω	kilohm
kc	kilocycle
kHz	kilohertz
L	inductance
λ	lambda—wavelength
$\gg$	large compared with
$<$	less than
LF	low frequency
lg	length or long
LV	low voltage
M	mega or 10^6
m	milli or 10^{-3}
MΩ or meg	megohm
μ	micro or 10^{-6}
mc	megacycle
met.	metal
MHz	megahertz
mm	millimeter
ms	millisecond
—	minus
mtg hdw	mounting hardware
n	nano or 10^{-9}
no. or #	number
ns	nanosecond
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
Ω	omega—ohms
ω	omega—angular frequency
p	pico or 10^{-12}
/	per
%	percent
PHB	pan head brass
ϕ	phi—phase angle
π	pi—3.1416
PHS	pan head steel
+	plus
$\pm$	plus or minus
PIV	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
pwr	power
Q	figure of merit
RC	resistance capacitance
RF	radio frequency
RFI	radio frequency interference (see EMI)
RHB	round head brass
ρ	rho—resistivity
RHS	round head steel
r/min or rpm	revolutions per minute
RMS	root mean square
s or sec.	second
SE	single end
Si	silicon
SN or S/N	serial number
$\ll$	small compared with
T	tera or 10^{12}
TC	temperature compensated
TD	tunnel diode
THB	truss head brass
θ	theta—angular phase displacement
thk	thick
THS	truss head steel
tub.	tubular
UHF	ultra high frequency
V	volt
VAC	volts, alternating current
var	variable
VDC	volts, direct current
VHF	very high frequency
VSWR	voltage standing wave ratio
W	watt
w	wide or width
w/	with
w/o	without
WW	wire-wound
xmfr	transformer

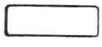
PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.
	Screwdriver adjustment.
	Control, adjustment or connector.

SECTION 5
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
		Bulb			
B1101	150-0065-00		10 V	Green Lens	
		Capacitors			
Tolerance ±20% unless otherwise indicated.					
C961	290-0114-00		47 µF	Elect. 6 V	
C962	290-0114-00		47 µF	Elect. 6 V	
C963	290-0114-00		47 µF	Elect. 6 V	
C964	290-0114-00		47 µF	Elect. 6 V	
C965	290-0114-00		47 µF	Elect. 6 V	
C966	290-0114-00		47 µF	Elect. 6 V	
C967	290-0114-00		47 µF	Elect. 6 V	
C968	290-0114-00		47 µF	Elect. 6 V	
C1105	290-0213-00		10 µF	Elect. 450 V	
C1112	290-0278-00		550 µF	Elect. 50 V	
C1139	290-0309-00		100 µF	Elect. 25 V	
C1143	290-0148-00		10,000 µF	Elect. 25 V	
C1164	290-0309-00		100 µF	Elect. 25 V	
C1172	290-0390-00		32,000 µF	Elect.	+75%-10%
C1173	290-0390-00		32,000 µF	Elect.	+75%-10%
C1189	290-0326-00		820 µF	Elect. 6 V	10%
C1203	290-0320-00		4,5000 µF	Elect. 40 V	+100%-10%
C1239	290-0301-00		10 µF	Elect. 20 V	10%
		Semiconductor Device, Diodes			
D1104	*152-0107-00		Silicon	Replaceable by 1N647	
D1112	152-0199-00		Rectifier Bridge	MDA 962-3 (Motorola)	
D1142	*152-0274-00		Silicon	Replaceable by 1N1200	
D1143	*152-0274-00		Silicon	Replaceable by 1N1200	
D1172	152-0088-00		Silicon	1N3209	

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
		Semiconductor Device, Diodes (cont)		
D1173	152-0088-00			Silicon 1N3209
D1202	152-0198-00			Silicon MR 1032A (Motorola)
D1203	152-0198-00			Silicon MR 1032A (Motorola)
D1204	152-0333-00			Silicon High Speed and Conductance
D1205	152-0333-00			Silicon High Speed and Conductance
D1301	*152-0185-00			Silicon Replaceable by 1N4152
D1302	*152-0185-00			Silicon Replaceable by 1N4152
D1303	*152-0185-00			Silicon Replaceable by 1N4152
D1304	*152-0185-00			Silicon Replaceable by 1N4152
		Connectors		
J112	131-0294-03			36 Pin, Female
J206	131-0294-02			36 Pin, Female
J231	131-0294-06			36 Pin, Female
J232	131-0294-06			36 Pin, Female
J233	131-0294-06			36 Pin, Female
J234	131-0294-06			36 Pin, Female
J235	131-0294-06			36 Pin, Female
J236	131-0294-06			36 Pin, Female
J237	131-0294-06			36 Pin, Female
		Filter		
FL1101	119-0028-03			2 X 3A 250 V AC, 450 Hz
		Fuses		
F1100	159-0082-00			15 A 1AG Fast-Blo
F1101	159-0005-00			3 A 3AG Slo-Blo
F1102	159-0034-00			1.6 A 3AG Slo-Blo
F1103	159-0082-00			15 A 1AG Fast-Blo
		Transistors		
Q1137	*151-0140-00			Silicon Selected from 2N3055
Q1157	*151-0140-00			Silicon Selected from 2N3055
Q1161	*151-0141-00			Silicon Selected from 40251
Q1186	151-0102-00			Germanium MP 504 (Motorola)
Q1187	*151-0140-00			Silicon Selected from 2N3055
Q1237	*151-0141-00			Silicon Selected from 40251

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
				Resistors		
Resistors are fixed, composition, ±10% unless otherwise indicated.						
R969	301-0150-00			15 Ω	1/2 W	5%
R1104	315-0101-00			100 Ω	1/4 W	5%
R1105	301-0304-00			300 kΩ	1/2 W	5%
R1106	308-0206-00			7.5 kΩ	5 W WW	5%
R1111	307-0093-00			1.2 Ω	1/2 W	5%
R112	301-0273-00			27 kΩ	1/2 W	5%
R1137	307-0093-00			1.2 Ω	1/2 W	5%
R1143	301-0103-00			10 kΩ	1/2 W	5%
R1159	315-0181-00			180 Ω	1/4 W	5%
R1160	308-0244-00			0.3 Ω	0.2 W WW	
R1161	308-0244-00			0.3 Ω	0.2 W WW	
R1162	308-0244-00			0.3 Ω	0.2 W WW	
R1187	307-0058-00			5.6 Ω	1/2 W	5%
R1189	175-0518-00			22 Solid 10 inch wire		
R1203	301-0103-00			10 kΩ	1/2 W	5%
R1237	307-0093-00			1.2 Ω	1/2 W	5%
R1238	*308-0090-00			0.25 Ω	1/2 W WW	
R1301	315-0152-00			1.5 kΩ	1/4 W	5%
R1302	315-0152-00			1.5 kΩ	1/4 W	5%
R1303	315-0152-00			1.5 kΩ	1/4 W	5%
R1304	315-0152-00			1.5 kΩ	1/4 W	5%
				Switches		
SW1101	260-0276-00			Toggle POWER		
SW1102[1]						
SW1102[1]						
				Thermal Cutout		
TK1101	260-0413-00			175°F	±5°F	
				Transformer		
T1101	*120-0513-00			Power		

[1] See Mechanical Parts List. Line Voltage Selector Body (*204-0279-00)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
		P13 Circuit Card Assembly			
	*670-0251-00			Complete Card	
		Capacitors			
Tolerance ±20% unless otherwise indicated.					
C1114	290-0245-00			1.5 μF	Elect. 10 V
C1119	290-0177-00			1 μF	Elect. 50 V
C1121	290-0187-00			4.7 μF	Elect. 35 V
C1134	283-0003-00			0.01 μF	Cer 150 V
C1149	290-0187-00			4.7 μF	Elect. 50 V
C1157	283-0003-00			0.01 μF	Cer 150 V
C1184	283-0003-00			0.01 μF	Cer 150 V
C1199	290-0187-00			4.7 μF	Elect. 35 V
C1205	290-0177-00			1 μF	Elect. 50 V
C1217	290-0187-00			4.7 μF	Elect. 35 V
C1222	283-0003-00			0.01 μF	Cer 150 V
C1256	290-0296-00			100 μF	Elect. 20 V
C1265	290-0114-00			47 μF	Elect. 6 V
C1275	290-0114-00			47 μF	Elect. 6 V
C1284	283-0001-00			0.005 μF	Cer 500 V
C1291	283-0067-00			0.001 μF	Cer 200 V
C1293	290-0135-00			15 μF	Elect. 20 V
C1294	283-0067-00			0.001 μF	Cer 200 V
		Semiconductor Device, Diodes			
D1114	152-0212-00			Zener	1N936 9 V, 5%, TC
D1125	152-0333-00			Silicon	High Speed and Conductance
D1185	152-0333-00			Silicon	High Speed and Conductance
D1206	*152-0185-00			Silicon	Replaceable by 1N4152
D1217	152-0333-00			Silicon	High Speed and Conductance
D1256	152-0333-00			Silicon	High Speed and Conductance
D1265	152-0333-00			Silicon	High Speed and Conductance
D1266	152-0333-00			Silicon	High Speed and Conductance
D1275	152-0333-00			Silicon	High Speed and Conductance
D1276	152-0333-00			Silicon	High Speed and Conductance
D1285	*152-0185-00			Silicon	Replaceable by 1N4152
		Transistors			
Q1112	151-0220-00			Silicon	2N4122
Q1114	151-0220-00			Silicon	2N4122
Q1124	151-0220-00			Silicon	2N4122
Q1134	151-0220-00			Silicon	2N4122
Q1147	*151-0190-01			Silicon	Tek Spec

P13 Circuit Card Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
		Transistors (cont)		
Q1149	*151-0190-01			Silicon Tek Spec
Q1153	*151-0190-01			Silicon Tek Spec
Q1176	151-0220-00			Silicon 2N4122
Q1178	151-0220-00			Silicon 2N4122
Q1192	151-0220-00			Silicon 2N4122
Q1194	151-0220-00			Silicon 2N4122
Q1197	*151-0190-01			Silicon Tek Spec
Q1207	*151-0190-01			Silicon Tek Spec
Q1216	*151-0190-01			Silicon Tek Spec
Q1219	*151-0190-01			Silicon Tek Spec
Q1222	151-0208-00			Silicon 2N4036
Q1225	*151-0190-01			Silicon Tek Spec
Q1256	*151-0235-00			Silicon Tek Spec
Q1265	*151-0134-00			Silicon Replaceable by 2N2905
Q1275	*151-0134-00			Silicon Replaceable by 2N2905
Q1283	*151-0190-01			Silicon Tek Spec
Q1285	*151-0190-01			Silicon Tek Spec
Q1297	*151-0190-01			Silicon Tek Spec
		Resistors		
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R1113	321-0234-00	2.76 kΩ	1/8 W	Prec 1%
R1114	315-0101-00	100 Ω	1/4 W	5%
R1118	321-0262-01	5.23 kΩ	1/8 W	Prec 1/2%
R1119	315-0101-00	100 Ω	1/4 W	5%
R1120	311-0807-00	1 kΩ, Var		
R1121	321-0260-00	4.99 kΩ	1/8 W	Prec 1%
R1122	321-0251-00	4.02 kΩ	1/8 W	Prec 1%
R1123	315-0273-00	27 kΩ	1/4 W	5%
R1124	315-0273-00	27 kΩ	1/4 W	5%
R1125	321-0285-00	9.09 kΩ	1/8 W	Prec 1%
R1126	315-0101-00	100 Ω	1/4 W	5%
R1127	315-0301-00	300 Ω	1/4 W	5%
R1128	315-0393-00	39 kΩ	1/4 W	5%
R1134	315-0101-00	100 Ω	1/4 W	5%
R1136	315-0181-00	180 Ω	1/4 W	5%
R1144	321-0256-00	4.53 kΩ	1/8 W	Prec 1%
R1145	311-0807-00	1 kΩ, Var		
R1146	321-0256-00	4.53 kΩ	1/8 W	Prec 1%
R1147	315-0101-00	100 Ω	1/4 W	5%
R1148	323-0191-00	953 Ω	1/2 W	Prec 1%

P13 Circuit Card Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R1149	323-0195-00		1.05 kΩ	1/2 W	Prec	1%
R1151	315-0101-00		100 Ω	1/4 W		5%
R1152	315-0101-00		100 Ω	1/4 W		5%
R1154	315-0101-00		100 Ω	1/4 W		5%
R1156	315-0752-00		7.5 kΩ	1/4 W		5%
R1157	315-0511-00		510 Ω	1/4 W		5%
R1174	321-0278-00		7.68 kΩ	1/8 W	Prec	1%
R1175	311-0807-00		1 kΩ, Var			
R1176	321-0199-00		1.15 kΩ	1/8 W	Prec	1%
R1177	315-0101-00		100 Ω	1/4 W		5%
R1178	323-0141-00		287 Ω	1/2 W	Prec	1%
R1179	323-0215-00		1.69 kΩ	1/2 W	Prec	1%
R1181	315-0101-00		100 Ω	1/4 W		5%
R1182	315-0101-00		100 Ω	1/4 W		5%
R1184	315-0511-00		510 Ω	1/4 W		5%
R1185	315-0132-00		1.3 kΩ	1/4 W		5%
R1191	315-0332-00		3.3 kΩ	1/4 W		5%
R1192	315-0750-00		75 Ω	1/4 W		5%
R1193	315-0752-00		7.5 kΩ	1/4 W		5%
R1194	315-0223-00		22 kΩ	1/4 W		5%
R1195	311-0480-00		500 Ω, Var			
R1196	315-0163-00		16 kΩ	1/4 W		5%
R1204	315-0102-00		1 kΩ	1/4 W		5%
R1205	301-0562-00		5.6 kΩ	1/2 W		5%
R1206	315-0103-00		10 kΩ	1/4 W		5%
R1210	311-0807-00		1 kΩ, Var			
R1211	321-0287-00		9.53 kΩ	1/8 W	Prec	1%
R1212	321-0256-00		4.53 kΩ	1/8 W	Prec	1%
R1214	315-0101-00		100 Ω	1/4 W		5%
R1216	323-0257-00		4.64 kΩ	1/2 W	Prec	1%
R1217	323-0202-00		1.24 kΩ	1/2 W	Prec	1%
R1219	315-0101-00		100 Ω	1/4 W		5%
R1221	315-0101-00		100 Ω	1/4 W		5%
R1222	315-0511-00		510 Ω	1/4 W		5%
R1224	305-0560-00		56 Ω	2 W		5%
R1226	315-0103-00		10 kΩ	1/4 W		5%
R1227	315-0151-00		150 Ω	1/4 W		5%
R1229	315-0181-00		180 Ω	1/4 W		5%
R1252	315-0470-00		47 Ω	1/4 W		5%
R1253	315-0102-00		1 kΩ	1/4 W		5%

P13 Circuit Card Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
			Resistors (cont)		
R1256	315-0102-00		1 kΩ	1/4 W	5%
R1264	315-0301-00		300 Ω	1/4 W	5%
R1268	315-0102-00		1 kΩ	1/4 W	5%
R1269	315-0150-00		15 Ω	1/4 W	5%
R1274	315-0301-00		300 Ω	1/4 W	5%
R1281	315-0202-00		2 kΩ	1/4 W	5%
R1282	315-0333-00		33 kΩ	1/4 W	5%
R1283	315-0104-00		100 kΩ	1/4 W	5%
R1284	315-0102-00		1 kΩ	1/4 W	5%
R1285	315-0102-00		1 kΩ	1/4 W	5%
R1286	315-0242-00		2.4 kΩ	1/4 W	5%
R1287	315-0102-00		1 kΩ	1/4 W	5%
R1289	311-0868-00		24 kΩ, Var		
R1291	315-0202-00		2 kΩ	1/4 W	5%
R1292	315-0681-00		680 Ω	1/4 W	5%
R1293	315-0102-00		1 kΩ	1/4 W	5%
R1294	315-0102-00		1 kΩ	1/4 W	5%
R1295	315-0102-00		1 kΩ	1/4 W	5%
R1296	315-0202-00		2 kΩ	1/4 W	5%
R1297	315-0472-00		4.7 kΩ	1/4 W	5%
			Integrated Circuits		
U1272	156-0011-00		Dual 2-Input NAND/ NOR Gate		Replaceable by Fairchild μL914
U1292	156-0011-00		Dual 2-Input NAND/ NOR Gate		Replaceable by Fairchild μL914

NOTES

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS
(Located behind diagrams)

SECTION 6
MECHANICAL PARTS LIST

FIG. 1. FRONT & FRONT FRAME PARTS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-1	333-1016-01			1	PANEL, front
-2	386-1291-00			1	SUBPANEL, front
-3	386-1401-00			1	PLATE, support panel
	- - - - - -			-	mounting hardware: (not included w/plate)
-4	210-0457-00			6	NUT, keps, 6-32 x 5/16 inch
-5	210-0273-00			2	LUG, solder #10 large
-6	214-0905-00			1	RETAINER, circuit card
	- - - - - -			-	mounting hardware: (not included w/retainer)
-7	212-0023-00			2	SCREW, 8-32 x 3/8 inch PHS
	210-0804-00			2	WASHER, flat, 0.170 ID x 3/8 inch, OD
-8	210-0458-00			2	NUT, keps, 8-32 x 11/32 inch
-9	348-0102-00			1	PAD, cushioning
	- - - - - -			-	mounting hardware: (not included w/pad)
	386-1436-00			2	PLATE, retaining
	213-0055-00			4	SCREW, thread forming, 2-32 x 3/16 inch PHS
-10	260-0276-00			1	SWITCH, toggle--POWER
	- - - - - -			-	switch includes:
-11	210-0414-00			1	NUT, hex 15/32-32 x 9/16
	- - - - - -			-	mounting hardware: (not included w/switch)
-12	354-0055-00			1	RING, locking, 15/32 ID x 23/32 inch, OD
-13	210-0902-00			1	WASHER, flat, 0.470 ID x 21/32 inch, OD
-14	210-0473-00			1	NUT, switch, 15/32-32 x 5/64 inch, 12 sided
-15	136-0164-00			1	SOCKET, bulb, 2 pin, incandescent
	- - - - - -			-	mounting hardware: (not included w/socket)
-16	220-0480-02			1	NUT, dodecagon, 0.375-32 x 0.438
-17	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch, OD
-18	210-0241-00			1	LUG, solder, 0.515 ID x 0.625 inch, OD
-19	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
-20	214-0553-00			2	LATCH SCREW, 1.388 inch long
-21	358-0255-00			2	BUSHING, plastic, latch screw
-22	351-0145-00			1	GUIDE, door
	- - - - - -			-	mounting hardware: (not included w/guide)
-23	210-0586-00			2	NUT, keps, 4-40 x 1/4
-24	426-0343-05			1	FRAME, section, bottom
-25	426-0344-00			1	FRAME, section, top
-26	407-0296-05			1	BRACKET, angle, right
	- - - - - -			-	mounting hardware: (not included w/bracket)
-27	212-0574-00			2	SCREW, 10-32 x 0.434 inch, FHS

FIG. 1. FRONT & FRONT FRAME PARTS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-28	407-0296-00			1		BRACKET, angle, left
	- - - - - -			-		mounting hardware: (not included w/bracket)
-29	212-0574-00			2		SCREW, 10-32 x 0.434 inch, FHS
-30	367-0076-00			2		HANDLE
	- - - - - -			-		mounting hardware for each: (not included w/handle)
-31	212-0562-00			2		SCREW, 10-32 x 7/8 inch, FHS
-32	426-0326-01			1		FRAME, section, right front or left rear
	- - - - - -			-		mounting hardware: (not included w/frame)
-33	212-0574-00			2		SCREW, 10-32 x 0.434 inch, FHS
-34	124-0188-00			1		STRIP, trim, 16.3 x 0.876 inch
-35	426-0325-01			1		FRAME, section, left front or right rear
	- - - - - -			-		mounting hardware: (not included w/frame)
-36	212-0574-00			2		SCREW, 10-32 x 0.434 inch, FHS
-37	377-0151-00			1		INSERT, corner frame section
	- - - - - -			-		mounting hardware: (not included w/insert)
-38	212-0507-00			2		SCREW, 10-32 x 3/8 inch, PHS
-39	214-0866-00			1		HINGE, outer half
	- - - - - -			-		mounting hardware: (not included w/hinge)
	212-0507-00			2		SCREW, 10-32 x 3/8 inch, PHS
-40	214-1034-00			1		HINGE, inner half (pair)
	- - - - - -			-		mounting hardware: (not included w/hinge)
-41	213-0159-00			2		SCREW, 3-48 x 1/8 inch, PHS
-42	214-0864-00			2		PIN, hinge, 3-48 inch thread ID x 1.363 inches long
-43	407-0451-00			1		SUPPORT, arm, door
	- - - - - -			-		mounting hardware: (not included w/support)
-44	210-0457-00			1		NUT, keps, 6-32 x 5/16 inch

FIG. 1. FRONT & FRONT FRAME PARTS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description (1 2 3 4 5)
1-45	214-1033-00			1	ARM, cable retractor
	- - - - - -			-	mounting hardware: (not included w/arm)
-46	210-0992-00			2	WASHER, plastic 0.265 ID x 0.437 OD
	166-0029-00			1	TUBE, spacer, 0.180 ID x 1/4 OD x 1/8 inch long
-47	210-0804-00			1	WASHER, flat, 0.170 ID x 3/8 inch, OD
	210-0008-00			1	LOCKWASHER, internal, #8
-48	210-0401-00			1	NUT, hex., cap 6-32 x 5/16 inch
-49	348-0020-00			2	GROMMET, rubber, shockmount
-50	212-0540-00			1	SCREW, 10-32 x 5 1/2 inch, HHS
-51	220-0410-00			1	NUT, keps, 10-32 x 3/8 inch
-52	348-0067-00			1	GROMMET, plastic 5/16 inch diameter
-53	351-0142-00			1	GUIDE, rod, front
	- - - - - -			-	mounting hardware: (not included w/guide)
-54	212-0023-00			1	SCREW, 8-32 x 3/8 inch, PHS
	210-0458-00			1	NUT, keps, 8-32 x 11/32 inch
-55	351-0141-00			1	GUIDE, rod, rear
	- - - - - -			-	mounting hardware: (not included w/guide)
-56	212-0023-00			1	SCREW, 8-32 x 3/8 inch, PHS
	210-0458-00			1	NUT, keps, 8-32 x 11/32 inch
-57	343-0149-00			2	CLAMP, plastic, loop
-58	220-0465-00			1	NUT, block
	- - - - - -			-	mounting hardware: (not included w/nut)
	212-0070-00			1	SCREW, 8-32 x 5/16 inch, FHS
-59	670-0251-00			1	ASSEMBLY, circuit card--REGULATOR
	- - - - - -			-	assembly includes:
	388-0931-00			1	CARD, circuit
-60	136-0183-00			4	SOCKET, transistor, 3 pin
-61	136-0220-00			7	SOCKET, transistor, 3 pin
-62	136-0235-00			6	SOCKET, transistor, 3 pin
-63	136-0237-00			2	SOCKET, integrated circuit, 8 pin
-64	214-0579-00			7	PIN, test point
-65	214-0668-00			1	HEATSINK, transistor

FIG. 2. CIRCUIT CARD SUPPORTS & POWER CHASSIS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-1	386-1293-00			1	SUPPORT, bracket
	- - - - - -			-	mounting hardware: (not included w/support)
	212-0023-00			4	SCREW, 8-32 x 3/8 inch, PHS
-2	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	211-0538-00			1	SCREW, 6-32 x 5/16 inch, FHS
-3	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
-4	386-1294-00			1	SUPPORT, bracket
	- - - - - -			-	mounting hardware: (not included w/support)
	212-0023-00			4	SCREW, 8-32 x 3/8 inch, PHS
-5	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	211-0538-00			1	SCREW, 6-32 x 5/16 inch, FHS
-6	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
-7	407-0392-00			1	BRACKET, circuit card guide (bottom)
	- - - - - -			-	mounting hardware: (not included w/bracket)
	212-0574-00			2	SCREW, 10-32 x 0.434 inch, FHS
-8	220-0410-00			2	NUT, keps, 10-32 x 3/8 inch
-9	407-0391-00			1	BRACKET, circuit card guide (top)
	- - - - - -			-	mounting hardware: (not included w/bracket)
	212-0023-00			2	SCREW, 8-32 x 3/8 inch, PHS
-10	210-0458-00			2	NUT, keps, 8-32 x 11/32 inch
-11	351-0113-00			26	GUIDE, plastic, circuit card
-12	441-0752-00			1	CHASSIS, bulkhead
	- - - - - -			-	mounting hardware: (not included w/chassis)
	212-0023-00			4	SCREW, 8-32 x 3/8 inch, PHS
	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	212-0574-00			2	SCREW, 10-32 x 0.434 inch, FHS
-13	220-0410-00			2	NUT, keps, 10-32 x 3/8 inch
-14	358-0215-00			1	BUSHING, plastic, black
-15	337-1012-00			1	SHIELD, plastic
-16	343-0007-00			1	CLAMP, cable, plastic, 5/8 inch
	- - - - - -			-	mounting hardware: (not included w/clamp)
	212-0574-00			1	SCREW, 10-32 x 0.434 inch, FHS
-17	210-0863-00			1	WASHER, "D" shaped, #10
	220-0410-00			1	NUT, keps, 10-32 x 3/8 inch
-18	670-0270-00			1	ASSEMBLY, circuit board--MOTHER
	- - - - - -			-	assembly includes:
	388-0916-00			1	BOARD, circuit
-19	136-0180-00			13	SOCKET, connector, 56 pin
-20	214-0506-00			296	PIN, connector, square (male)
-21	214-0579-00			1	PIN, test point
-22	214-0702-00			26	KEY, polarizing, connector
	- - - - - -			-	mounting hardware: (not included w/assembly)
-23	211-0014-00			26	SCREW, 4-40 x 1/2 inch, PHS
-24	210-0586-00			26	NUT, keps, 4-40 x 1/4 inch

FIG. 2. CIRCUIT CARD SUPPORTS & POWER CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-25	441-0753-00			1	CHASSIS, power
	- - - - - -			-	mounting hardware: (not included w/chassis)
	212-0023-00			4	SCREW, 8-32 x 3/8 inch, PHS
	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	212-0585-00			4	SCREW, 10-32 x 1/2 inch, OHS
-26	210-0204-00			1	LUG, solder, SE #6
	- - - - - -			-	mounting hardware: (not included w/lug)
-27	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-28	252-0564-00			FT	GROMMET, plastic, 5 inches long
-29	344-0117-00			1	CLIP, capacitor mounting
	- - - - - -			-	mounting hardware: (not included w/clip)
-30	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-31	- - - - - -			1	THERMAL CUTOUT
	- - - - - -			-	mounting hardware: (not included w/thermal cutout)
-32	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-33	210-0201-00			3	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-34	- - - - - -			3	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-35	211-0578-00			2	SCREW, 6-32 x 7/16 inch, PHS
-36	386-0978-00			1	PLATE, insulator, mica
	210-0935-00			2	WASHER, fiber, 0.140 ID x 0.375 inch OD
	210-08030-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-37	- - - - - -			2	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-38	211-0511-00			2	SCREW, 6-32 x 1/2 inch, PHS
-39	386-0978-00			1	PLATE, insulator, mica
	210-0975-00			2	WASHER, plastic, 0.140 ID x 0.375 inch OD
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-40	- - - - - -			2	DIODE, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/diode)
-41	210-0207-00			1	LUG, solder, 3/8 ID x 5/8 inch OD, SE

FIG. 2. CIRCUIT CARD SUPPORTS & POWER CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-42	- - - - - -			2	DIODE
	- - - - - -			-	mounting hardware for each: (not included w/diode)
	210-0224-00			1	LUG, solder, SE #10 long
	210-0813-00			1	WASHER, fiber, #10
	210-0805-00			1	WASHER, flat, 0.204 ID x 0.438 inch OD
	220-0410-00			1	NUT, keps, 10-32 x 3/8 inch
-43	- - - - - -			1	LINE FILTER
	- - - - - -			-	mounting hardware: (not included w/filter)
-44	211-0503-00			2	SCREW, 6-32 x 3/16 inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-45	- - - - - -			1	TRANSFORMER
	- - - - - -			-	transofrmer includes:
-46	212-0522-00			4	SCREW, 10-32 x 2 1/2 inches, HEX HS
-47	210-0805-00			4	WASHER, flat, 0.204 ID x 0.438 inch OD
-48	210-0812-00			4	WASHER, fiber, 0.18 ID x 0.38 inch OD
	- - - - - -			-	mounting hardware: (not included w/transformer)
-49	220-0410-00			4	NUT, keps, 10-32 x 3/8 inch
-50	407-0407-00			1	BRACKET, transformer
-51	348-0056-00			1	GROMMET, plastic, 3/8 inch diameter
-52	407-0412-00			1	BRACKET, heat sink
-53	214-0984-00			1	HEAT SINK
	- - - - - -			-	mounting hardware: (not included w/heat sink)
-54	212-0541-00			2	SCREW, 10-32 x 5/8 inch, RHS
-55	210-0813-00			4	WASHER, fiber, shouldered, #10
	210-0805-00			2	WASHER, flat, 0.204 ID x 0.438 inch OD
	220-0410-00			2	NUT, keps, 10-32 x 3/8 inch
-56	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-57	210-0813-00			1	WASHER, fiber, shouldered, #10
-58	210-0206-00			1	LUG, solder, SE #10
-59	210-0410-00			1	NUT, hex., 10-32 x 3/8 inch
-60	- - - - - -			2	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-61	212-0541-00			1	SCREW, 10-32 x 5/8 inch, RHS
-62	220-0410-00			1	NUT, keps, 10-32 x 3/8 inch
-63	343-0064-00			2	CLAMP, capacitor, large
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-64	211-0507-00			3	SCREW, 6-32 x 5/16 inch, PHS
	210-0202-00			2	LUG, solder, SE #6
	210-0457-00			3	NUT, keps, 6-32 x 5/16 inch

FIG. 2. CIRCUIT CARD SUPPORTS & POWER CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-65	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	211-0513-00			1	SCREW, 6-32 x 5/8 inch, PHS
-66	211-0457-00			1	NUT, keps, 6-32 x 5/16 inch
-67	343-0065-00			1	CLAMP, capacitor, small
	- - - - - -			-	mounting hardware: (not included w/clamp)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-68	210-0273-00			4	LUG, solder, #10 large
-69	210-0224-00			2	LUG, solder, SE #10 long
-70	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-71	211-0588-00			2	SCREW, 6-32 x 3/4 inch, HHS
-72	432-0048-00			1	BASE, plastic, large capacitor mounting
	386-0254-00			1	PLATE, fiber, large capacitor mounting
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-73	200-0293-00			1	COVER, plastic, capacitor, 1.365 ID x 2 9/16 inch OD
-74	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-75	211-0534-00			2	SCREW, sems, 6-32 x 5/16 inch, PHS
	386-0252-00			1	PLATE, fiber, small capacitor mounting
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-76	200-0256-00			1	COVER, plastic, capacitor 1 inch ID x 2 1/32 inches long
-77	179-1272-00			1	CABLE HARNESS, inter-connecting
-78	179-1278-00			1	CABLE HARNESS, power
-79	124-0145-00			3	STRIP, ceramic, 7/16 inch h, w/20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0008-00			2	SPACER, plastic, 0.281 inch long

FIG. 2. CIRCUIT CARD SUPPORTS & POWER CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description (1 2 3 4 5)
2-80	124-0146-00			1	STRIP, ceramic, 7/16 inch h, w/16 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0008-00			2	SPACER, plastic, 0.281 inch long
-81	124-0120-00			1	STRIP, ceramic, 7/16 inch h, w/4 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0008-00			2	SPACER, plastic, 0.281 inch long
-82	124-0119-00			1	STRIP, ceramic, 7/16 inch h, w/2 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0008-00			1	SPACER, plastic, 0.281 inch long
-83	124-0106-00			4	STRIP, ceramic, 7/16 inch h, w/11 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-84	124-0120-00			1	STRIP, ceramic, 7/16 inch h, w/4 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-85	426-0349-00			2	FRAME, section, left & right
	- - - - - -			-	mounting hardware for each: (not included w/frame)
	212-0574-00			4	SCREW, 10-32 x 0.434 inch, FHS
-86	343-0089-00			1	CLAMP, cable, plastic, snap-in

FIG. 3. REAR & CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
3-1	386-1292-01			1	PANEL,rear
	- - - - - -			-	mounting hardware: (not included w/panel)
-2	211-0504-00			10	SCREW, 6-32 x 1/4 inch, PHS
-3	212-0507-00			4	SCREW, 10-32 x 3/8 inch, BHS
-4	210-0457-00			10	NUT,keps, 6-32 x 5/16 inch
	210-0202-00			2	LUG,solder, SE #6
-5	426-0330-00			1	FRAME, section, rear top
-6	426-0326-01			1	FRAME, section, left rear
	- - - - - -			-	mounting hardware: (not included w/frame)
-7	212-0574-00			2	SCREW, 10-32 x 0.434 inch, FHS
-8	426-0325-01			1	FRAME, section, right rear
	- - - - - -			-	mounting hardware: (not included w/frame)
-9	212-0574-00			2	SCREW, 10-32 x 0.434 inch, FHS
-10	124-0201-00			2	STRIP, trim, 6.45 x 1.009 inch
-11	426-0329-00			1	FRAME, section rear bottom
-12	348-0078-00			4	FOOT, plastic, cap
-13	348-0079-00			4	FOOT, plastic
	- - - - - -			-	mounting hardware for each: (not included w/foot)
-14	212-0082-00			1	SCREW, 8-32 x 1 1/4 inch, PHS
-15	210-0458-00			1	NUT, keps, 8-32 x 11/32 inch
-16	204-0279-00			1	ASSEMBLY, line voltage selector
	- - - - - -			-	mounting hardware: (not included w/assembly)
-17	210-0006-00			2	LOCKWASHER, internal, #6
-18	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
-19	200-0762-00			1	COVER, line voltage selector
	- - - - - -			-	cover includes:
-20	352-0102-00			2	HOLDER, fuse
	- - - - - -			-	mounting hardware: (not included w/holder)
-21	213-0088-00			1	SCREW, thread cutting, 4-40 x 1/4 inch
-22	161-0033-00			1	CORD, power, 3 conductor
	334-1205-00			1	TAG, power cord (not shown)
-23	358-0161-00			1	BUSHING, plastic, strain relief
-24	119-0031-00			1	ASSEMBLY, blower
	- - - - - -			-	mounting hardware: (not included w/assembly)
	211-0513-00			4	SCREW, 6-32 x 5/8 inch, PHS
	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch

FIG. 3. REAR & CABINET (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
3-25	214-0762-00			1	GRILL, fan
-26	378-0029-00			1	FILTER, air, plastic foam
-27	380-0119-00			1	HOUSING, filter
	- - - - - -			-	mounting hardware: (not included w/housing)
-28	211-0516-00			1	SCREW, 6-32 x 7/8 inch, PHS
-29	407-0442-00			1	BRACKET, transformer support
-30	200-0729-00			2	PLATE, connector hole
	- - - - - -			-	mounting hardware for each: (not included w/plate)
-31	211-0504-00			2	SCREW, 6-32 x 1/4 inch, PHS
	630-0226-00			1	ASSEMBLY, connector, J235, J236, J237, J112
	- - - - - -			-	assembly includes:
-32	131-0294-06			3	CONNECTOR, 36 pin, J235, J236, J237
-33	131-0294-03			1	CONNECTOR, 36 pin, J112
	- - - - - -			-	mounting hardware for each: (not included w/ connector)
-34	211-0062-00			2	SCREW, 2-56 x 5/16 inch, PHS
	210-0001-00			2	LOCKWASHER, internal, #2
-35	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-36	179-1270-00			1	CABLE HARNESS, J235, J236, J237
-37	179-1280-00			1	CABLE HARNESS, J112
-38	386-1244-00			1	PLATE, connector mounting
	- - - - - -			-	mounting hardware: (not included w/assembly)
	211-0504-00			4	SCREW, 6-32 x 1/4 inch, PHS
	630-0227-00			1	ASSEMBLY, connector, J206, J231, J232, J233, J234
	- - - - - -			-	assembly includes:
-39	131-0294-02			1	CONNECTOR, 36 pin
	- - - - - -			-	mounting hardware: (not included w/connector)
	211-0062-00			2	SCREW, 2-56 x 5/16 inch, PHS
	210-0001-00			2	LOCKWASHER, internal, #2
-40	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-41	386-1245-00			1	PLATE, connector mounting
-42	179-1281-00			1	CABLE HARNESS, J206, J231, J232, J233, J234
-43	200-0817-00			1	COVER, connector mounting hole
	- - - - - -			-	mounting hardware: (not included w/cover)
	211-0062-00			2	SCREW, 2-56 x 5/16 inch
	210-0001-00			2	LOCKWASHER, internal, #2
	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
	630-0224-00			1	ASSEMBLY, connector, J231, J232, J233, J234
	- - - - - -			-	assembly includes:
-44	131-0294-06			4	CONNECTOR, 36 pin
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-45	211-0062-00			2	SCREW, 2-56 x 5/16 inch, PHS
	210-0001-00			2	LOCKWASHER, internal, #2
-46	210-0405-00			2	NUT, hex., 2-56 x 5/16 inch

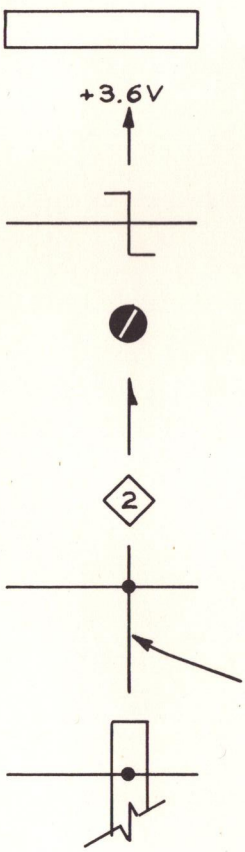
FIG. 3. REAR & CABINET (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
3-47	386-1244-00			1		PLATE, connector mounting
	- - - - - -			-		mounting hardware: (not included w/assembly)
-48	211-0504-00			7		SCREW, 6-32 x 1/4 inch, PHS
-49	179-1279-00			1		CABLE HARNESS, line voltage
-50	386-1139-00			1		CABINET, top
	- - - - - -			-		cabinet includes:
-51	214-0812-00			4		ASSEMBLY, latch
	- - - - - -			-		each assembly includes:
-52	214-0603-01			1		PIN, securing
-53	214-0604-00			1		SPRING
-54	386-0227-00			1		PLATE, plastic index
-55	386-0226-00			1		PLATE, locking
-56	386-1138-00			1		CABINET, bottom
	- - - - - -			-		cabinet includes:
-57	214-0812-00			4		ASSEMBLY, latch
	- - - - - -			-		each assembly includes:
-58	214-0603-01			1		PIN, securing
-59	214-0604-00			1		SPRING
-60	386-0227-00			1		PLATE, plastic, index
-61	386-0226-00			1		PLATE, locking
-62	426-0347-00			1		FRAME, section, bottom left
	- - - - - -			-		mounting hardware: (not included w/frame)
-63	212-0574-00			2		SCREW, 10-32 x 0.434 inch, FHS
-64	212-0585-00			2		SCREW, 10-32 x 0.50 inch, FHS
	220-0410-00			1		NUT, keps, 10-32 x 3/8 inch
-65	426-0348-00			1		FRAME, section, bottom right
	- - - - - -			-		mounting hardware: (not included w/frame)
-66	212-0574-00			2		SCREW, 10-32 x 0.434 inch, FHS
-67	212-0585-00			2		SCREW, 10-32 x 0.50 inch, FHS
	220-0410-00			1		NUT, keps, 10-32 x 3/8 inch
-68	351-0082-00			1		TRACK, slideout (pair)
	- - - - - -			-		mounting hardware: (not included w/track)
	212-0507-00			12		SCREW, 10-32 x 3/8 inch, PHS
	220-0410-00			12		NUT, keps, 10-32 x 3/8 inch

NOTES

SECTION 7
DIAGRAMS

Reference standards for the diagrams are Graphic Symbols standards USAS Y32.2-1967 and ASA Y32.14-1966. The following special symbols are also used:



Identification of front-panel control or connector

Connection to voltage source

Transition symbol across clock pulse or shift input indicates input is sensitive to negative-going edge

Screwdriver adjustment

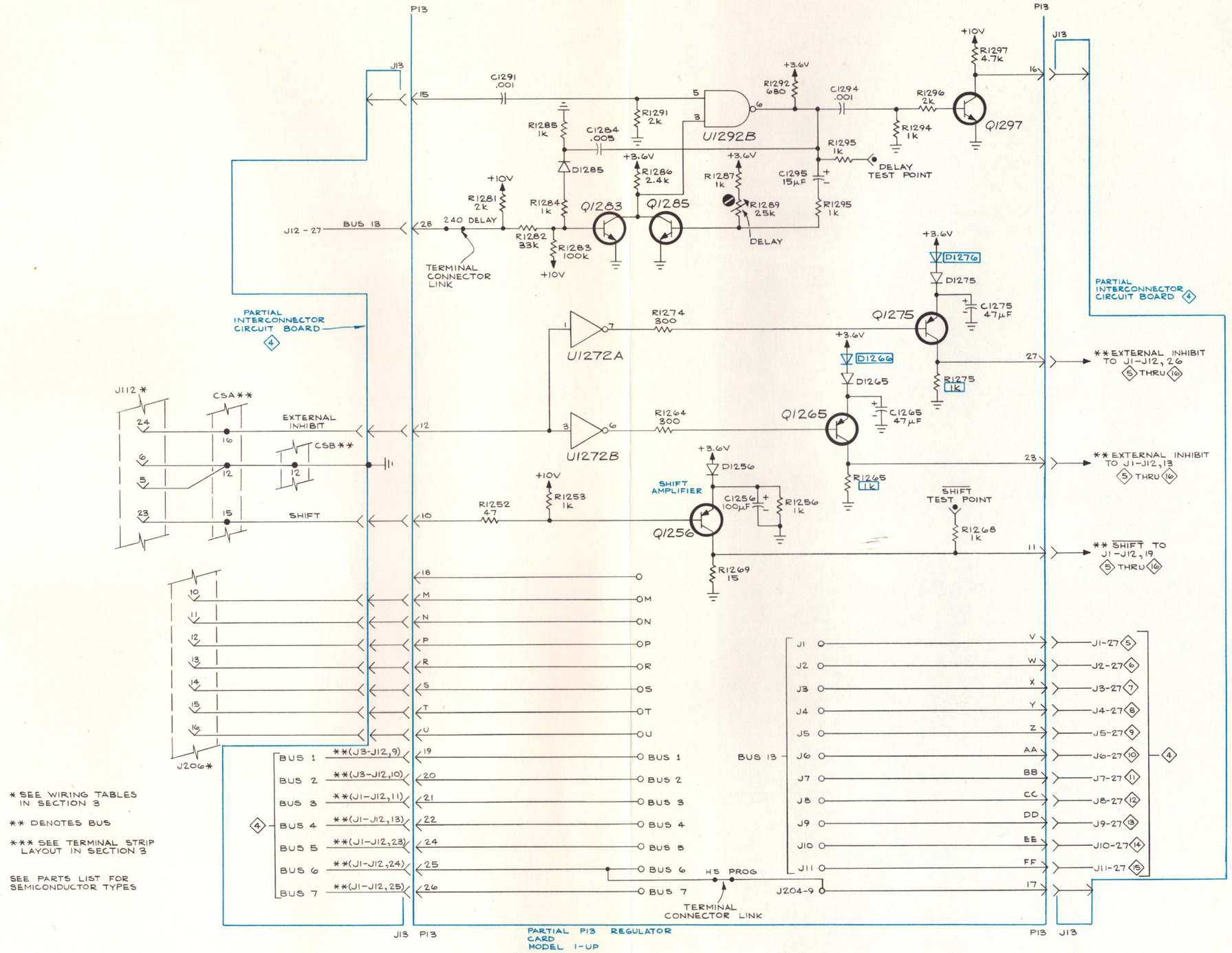
Clockwise control rotation in direction of arrow

Diagram identification number

Connection soldered to circuit board

Blue line encloses components located on circuit board or card

Ceramic terminal strip connection



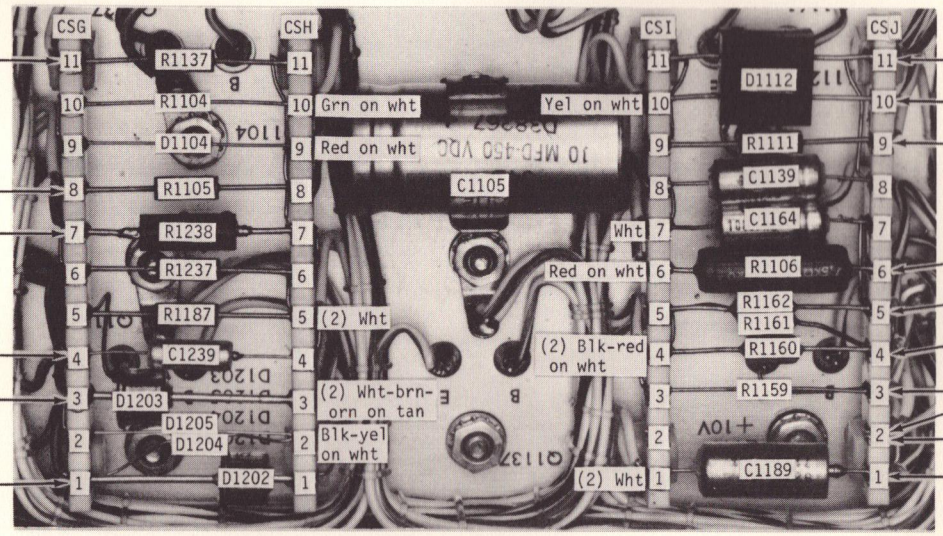
* SEE WIRING TABLES IN SECTION 3

** DENOTES BUS

*** SEE TERMINAL STRIP LAYOUT IN SECTION 3

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

(Bottom of Instrument)

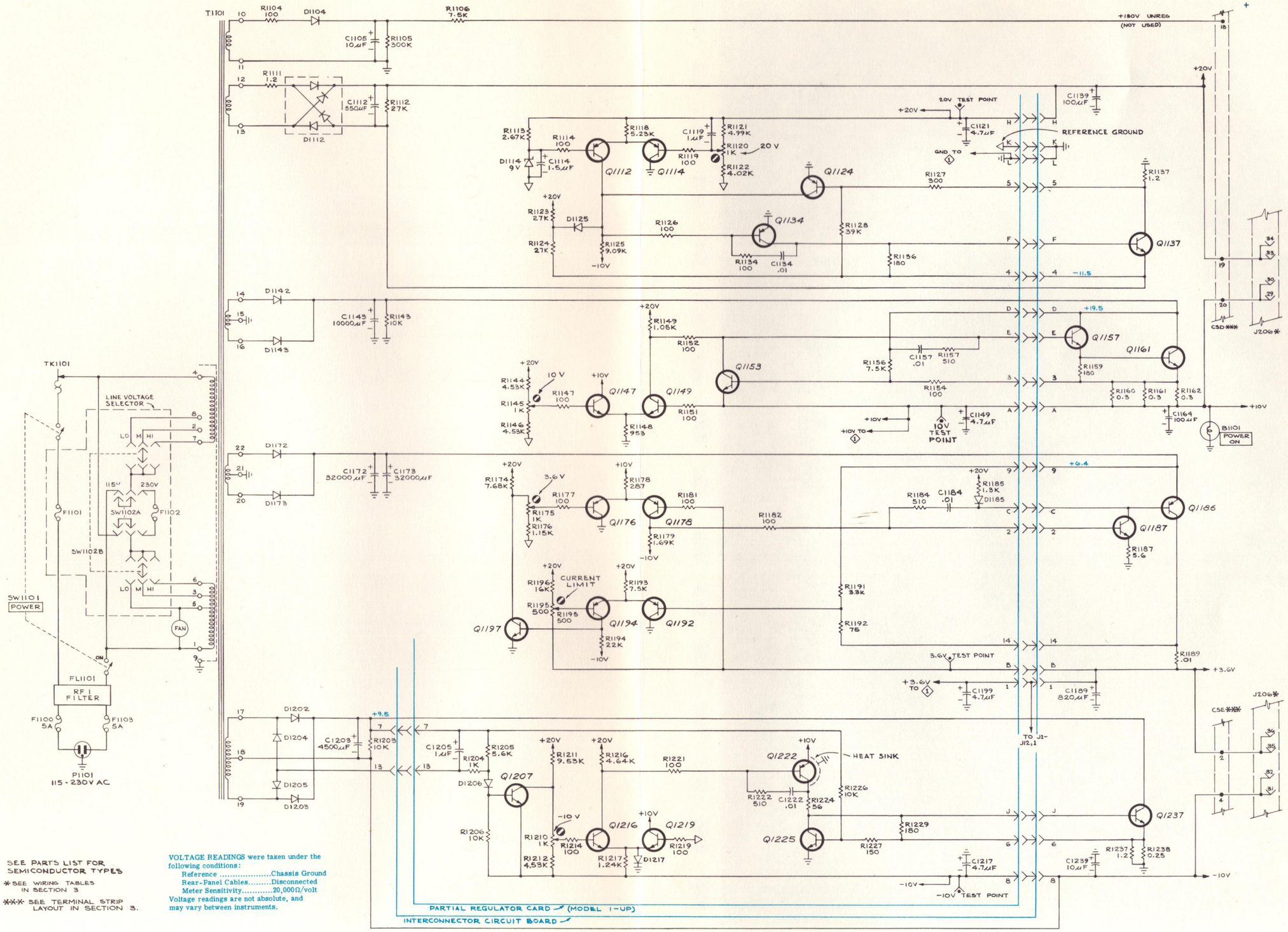


Front of Instrument

NOTE

See terminal strip layout in Section 3 for information concerning terminal strips on top side of chassis.

Power Supply Terminal Strip Layout

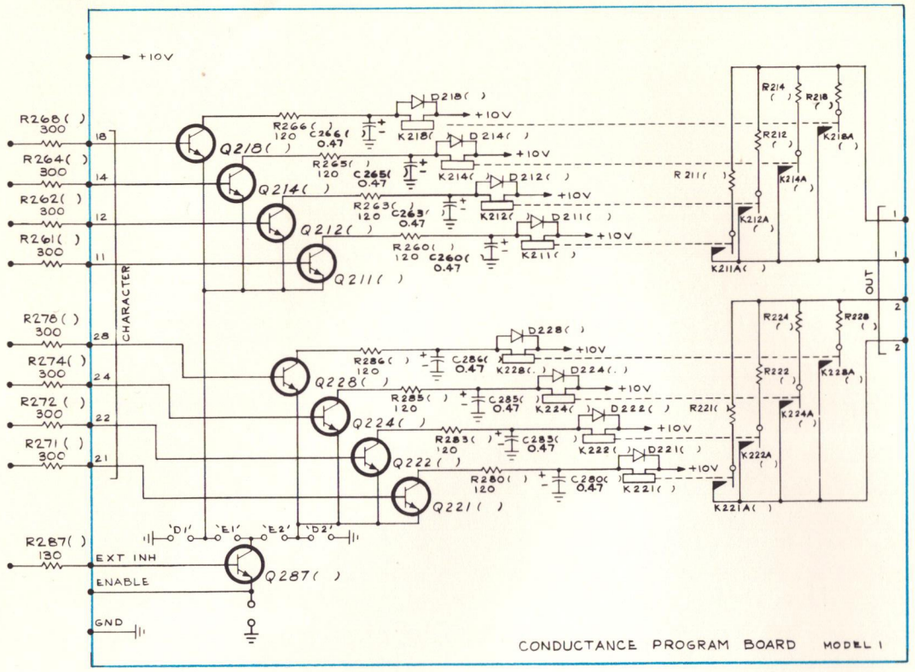


SEE PARTS LIST FOR SEMICONDUCTOR TYPES

*SEE WIRING TABLES IN SECTION 3

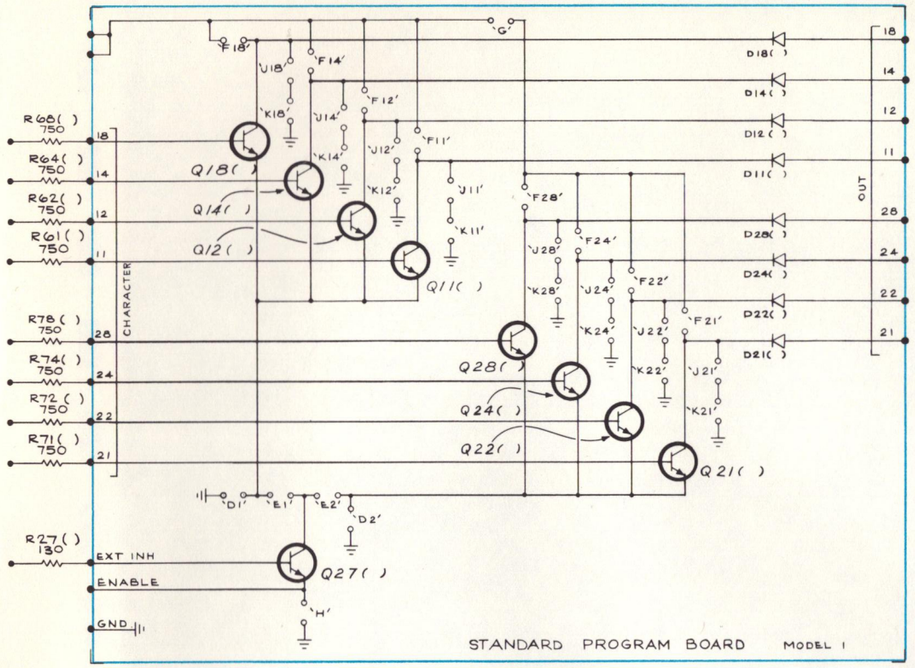
***SEE TERMINAL STRIP LAYOUT IN SECTION 3.

VOLTAGE READINGS were taken under the following conditions:
Reference .....Chassis Ground
Rear-Panel Cables.....Disconnected
Meter Sensitivity.....20,000Ω/volt
Voltage readings are not absolute, and may vary between instruments.

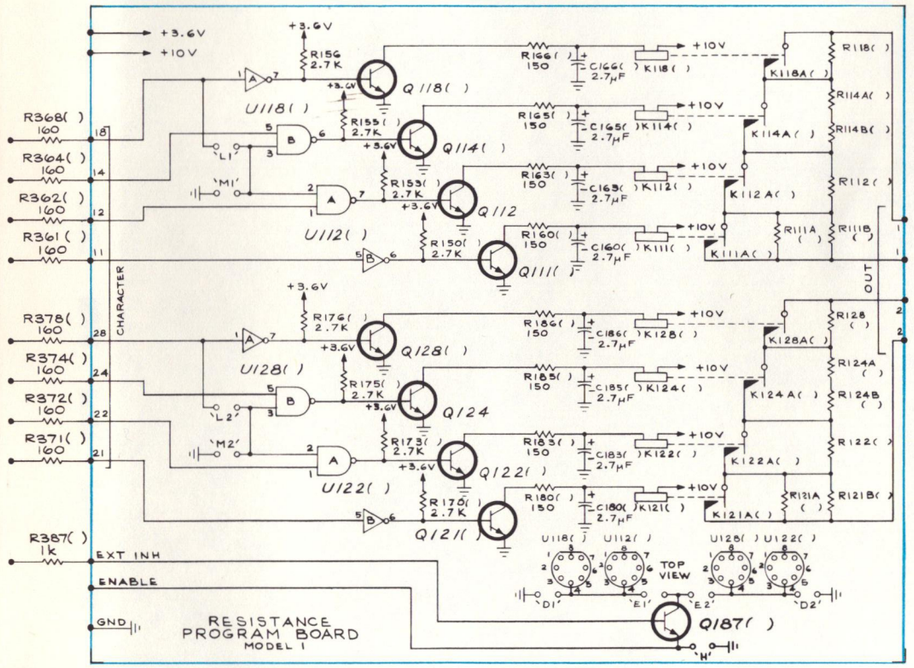


CONDUCTANCE PROGRAM BOARD MODEL 1

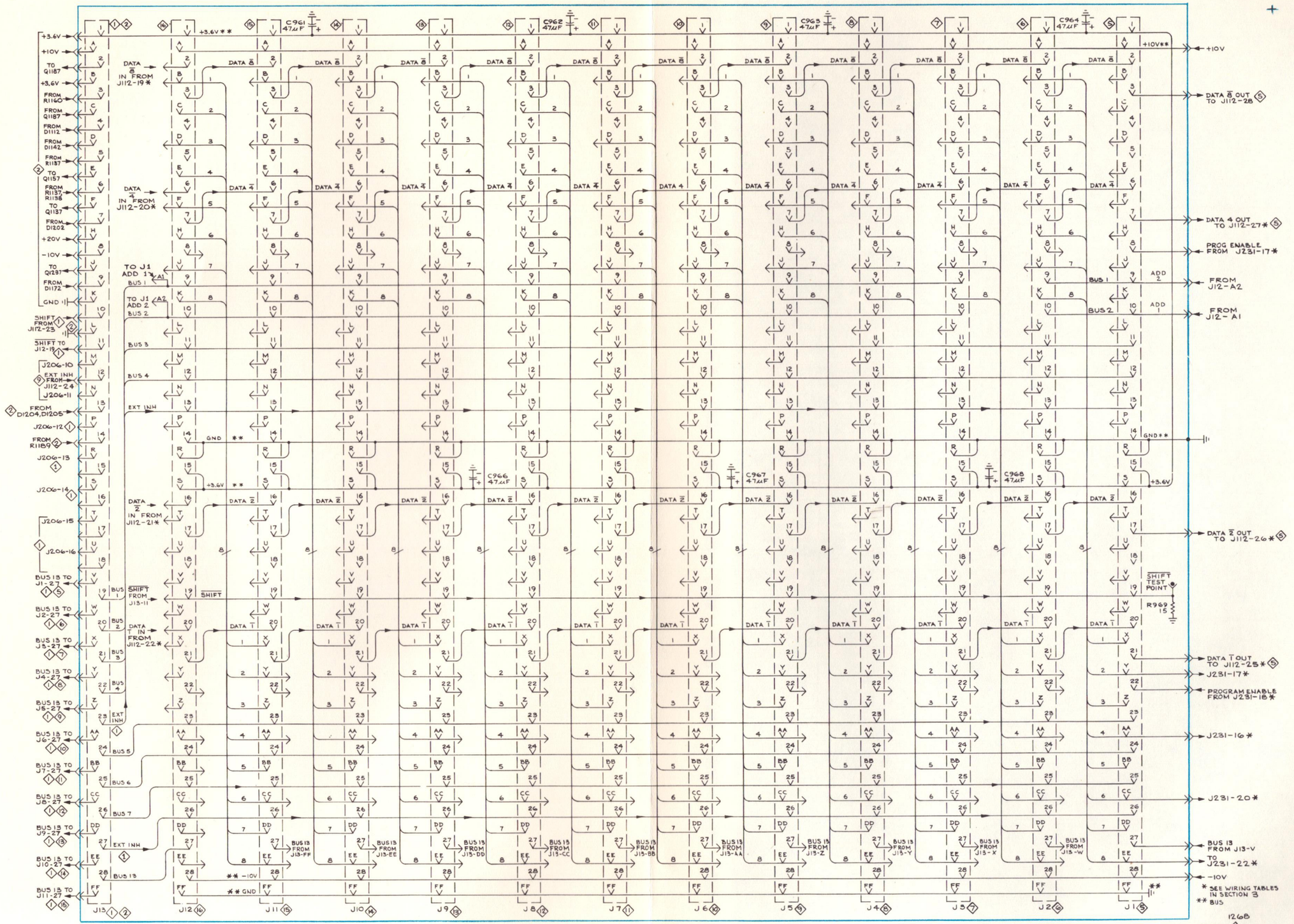
NOTE
The diagrams of this page may be reproduced for designing program card assemblies. Do not cut up this page for that purpose.
These diagrams are also available in a pad which includes 50 standard program board diagrams and 25 each of the resistance and conductance program board diagrams.
Order Tektronix Part Number 070-0940-00.



STANDARD PROGRAM BOARD MODEL 1

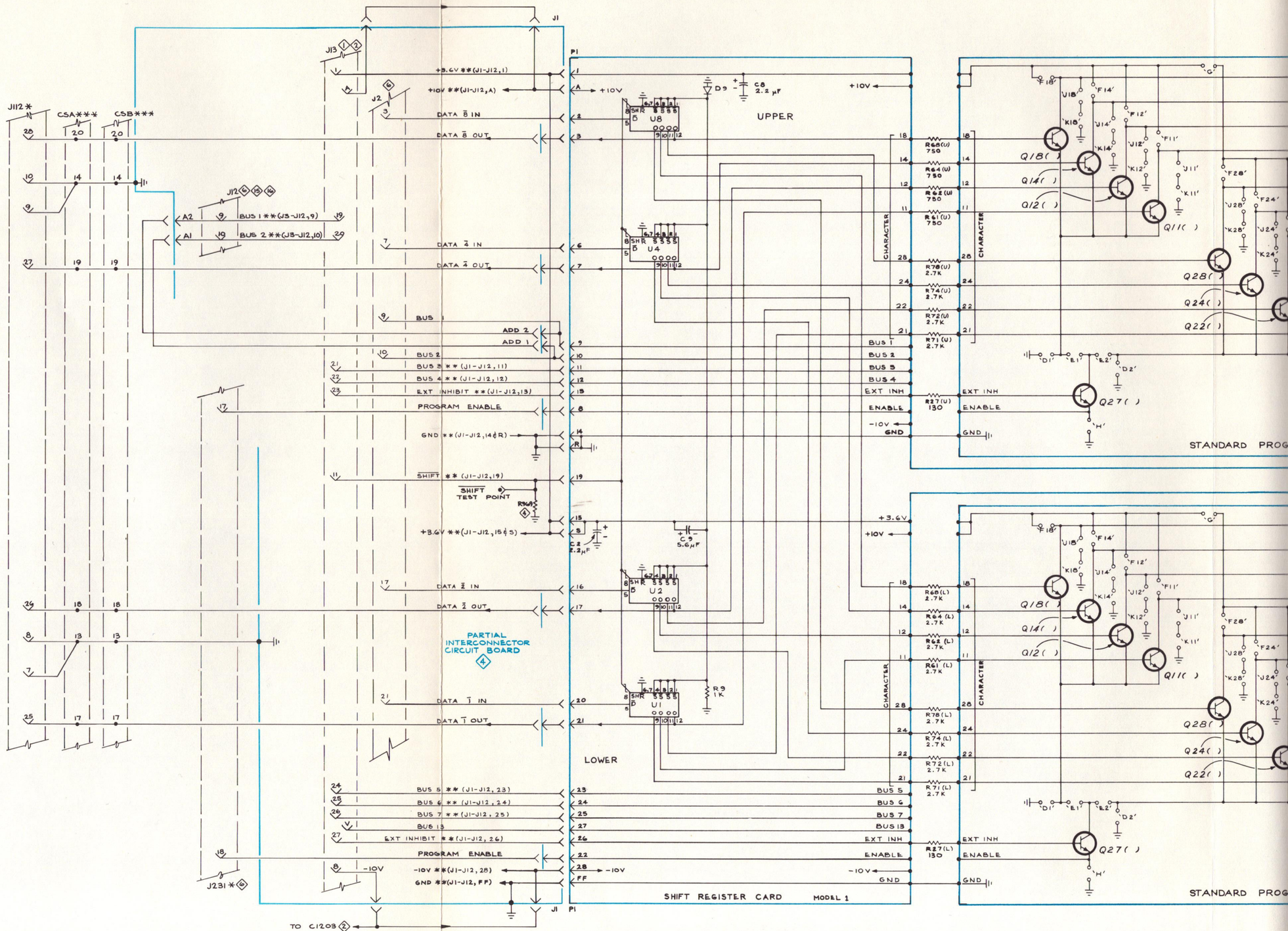


RESISTANCE PROGRAM BOARD MODEL 1

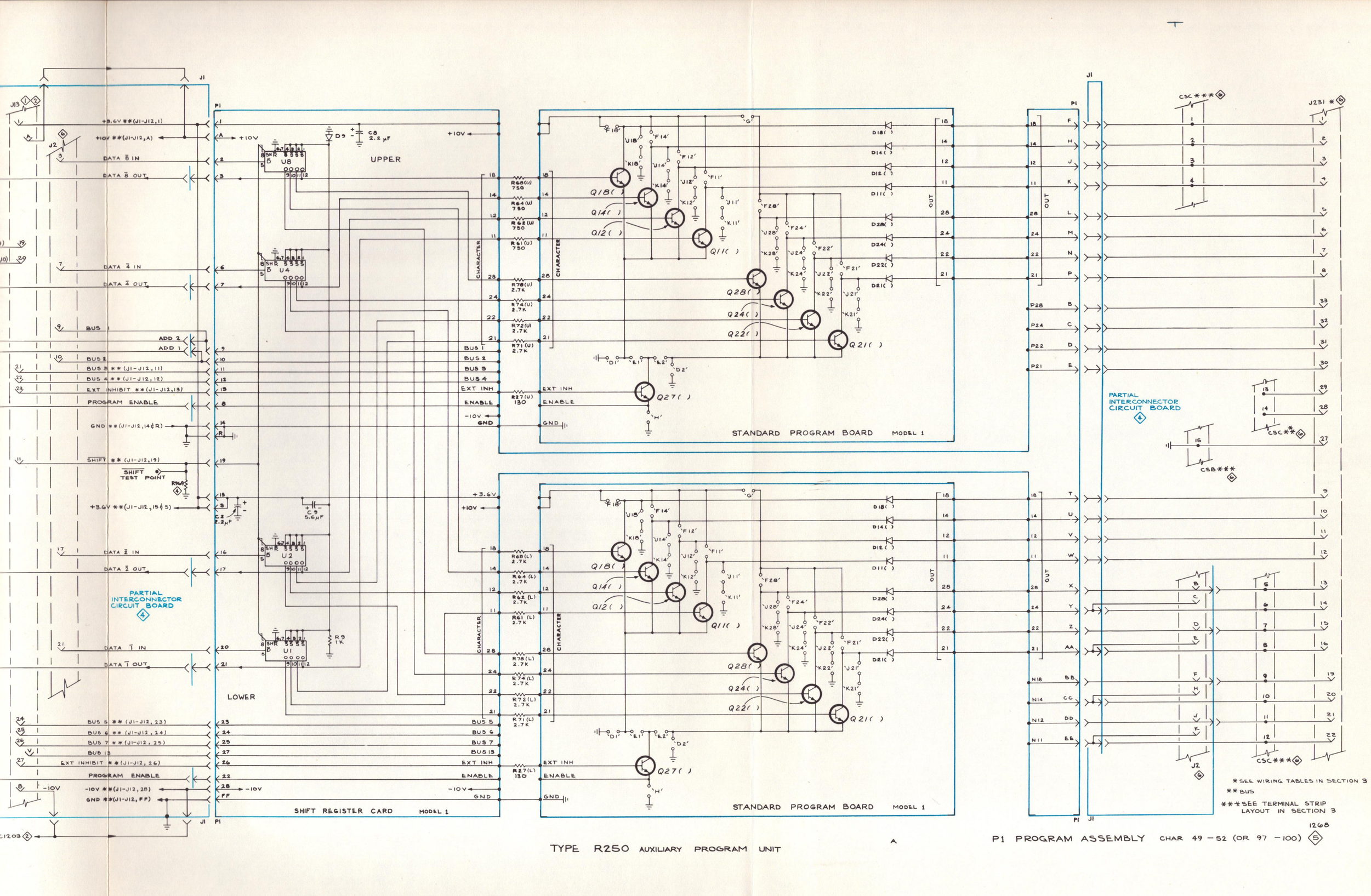


+ TYPE R250 AUXILIARY PROGRAM UNIT

INTERCONNECTOR CIRCUIT BOARD (4)



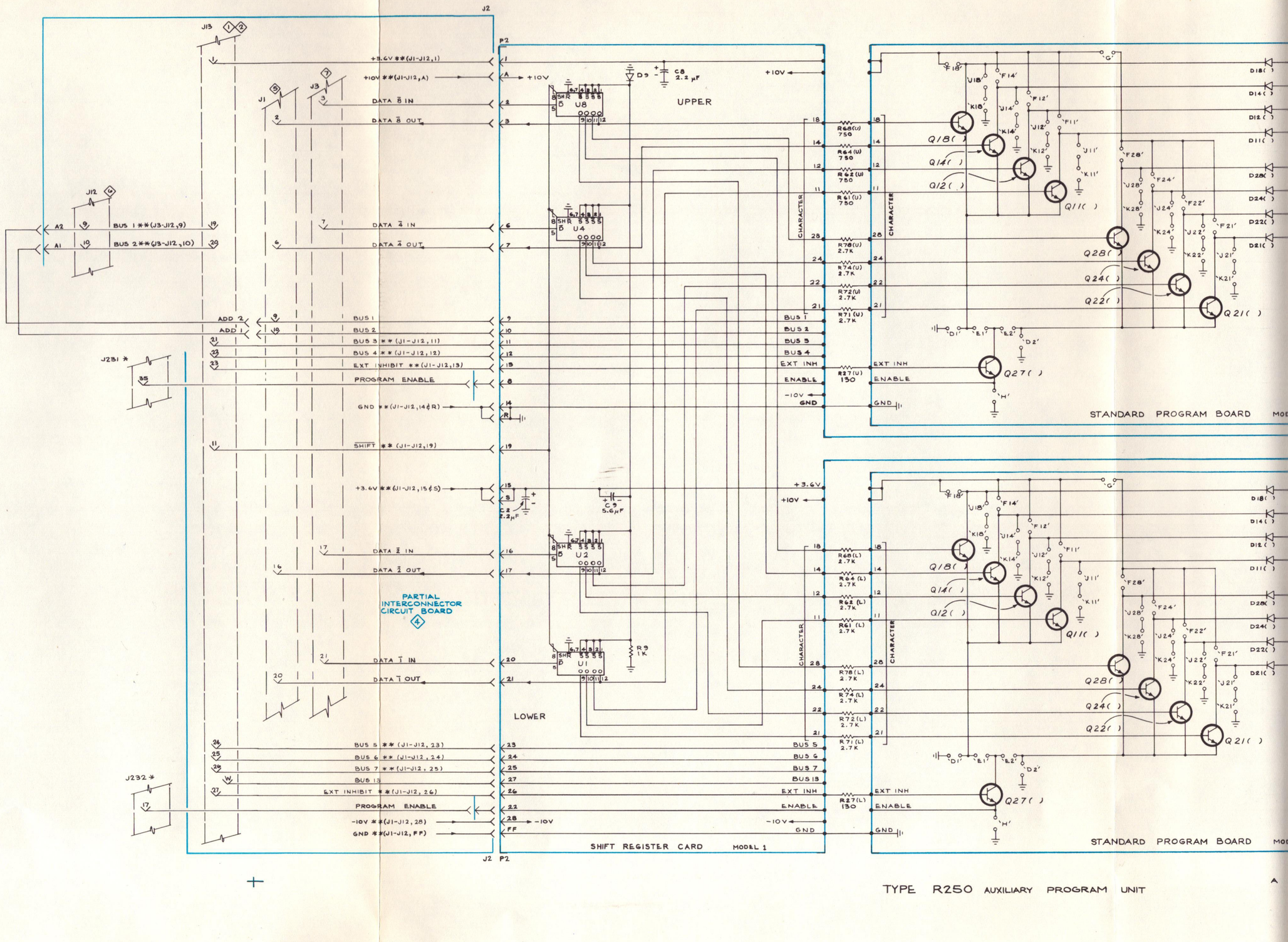
TYPE R250 AUXILIARY PROGRAM UNIT



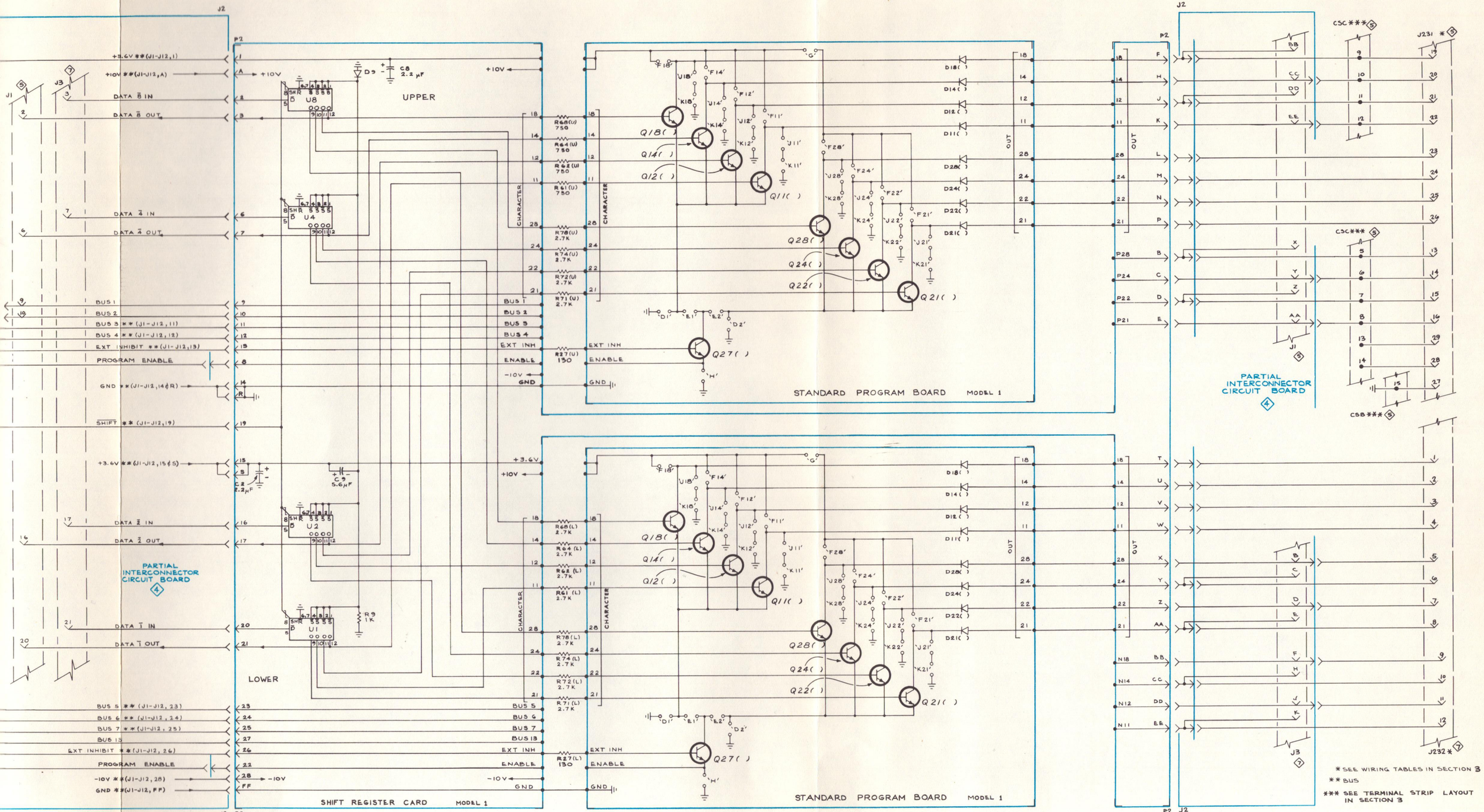
TYPE R250 AUXILIARY PROGRAM UNIT

A

P1 PROGRAM ASSEMBLY CHAR 49 – 52 (OR 97 – 100) 5



TYPE R250 AUXILIARY PROGRAM UNIT



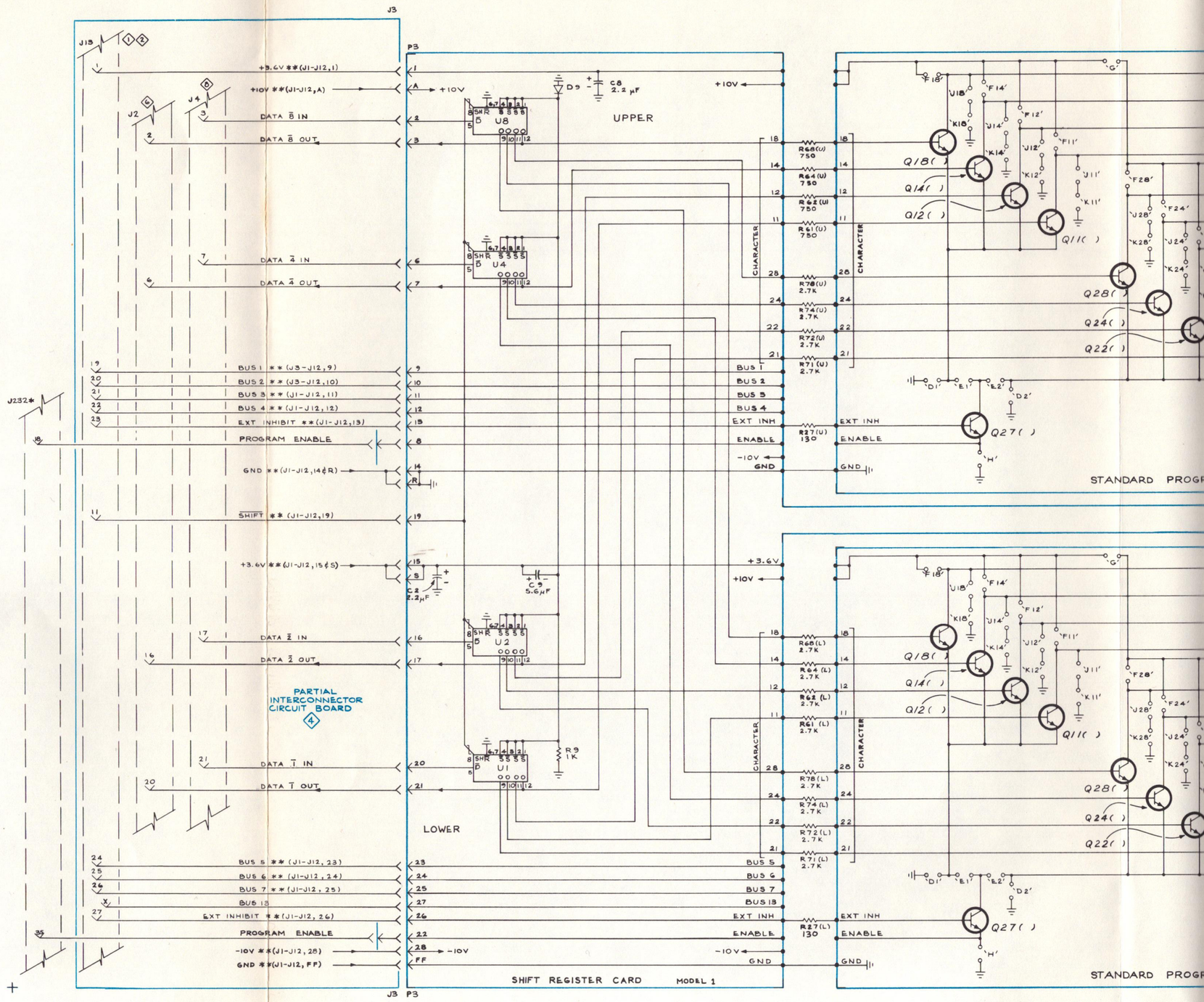
TYPE R250 AUXILIARY PROGRAM UNIT

A

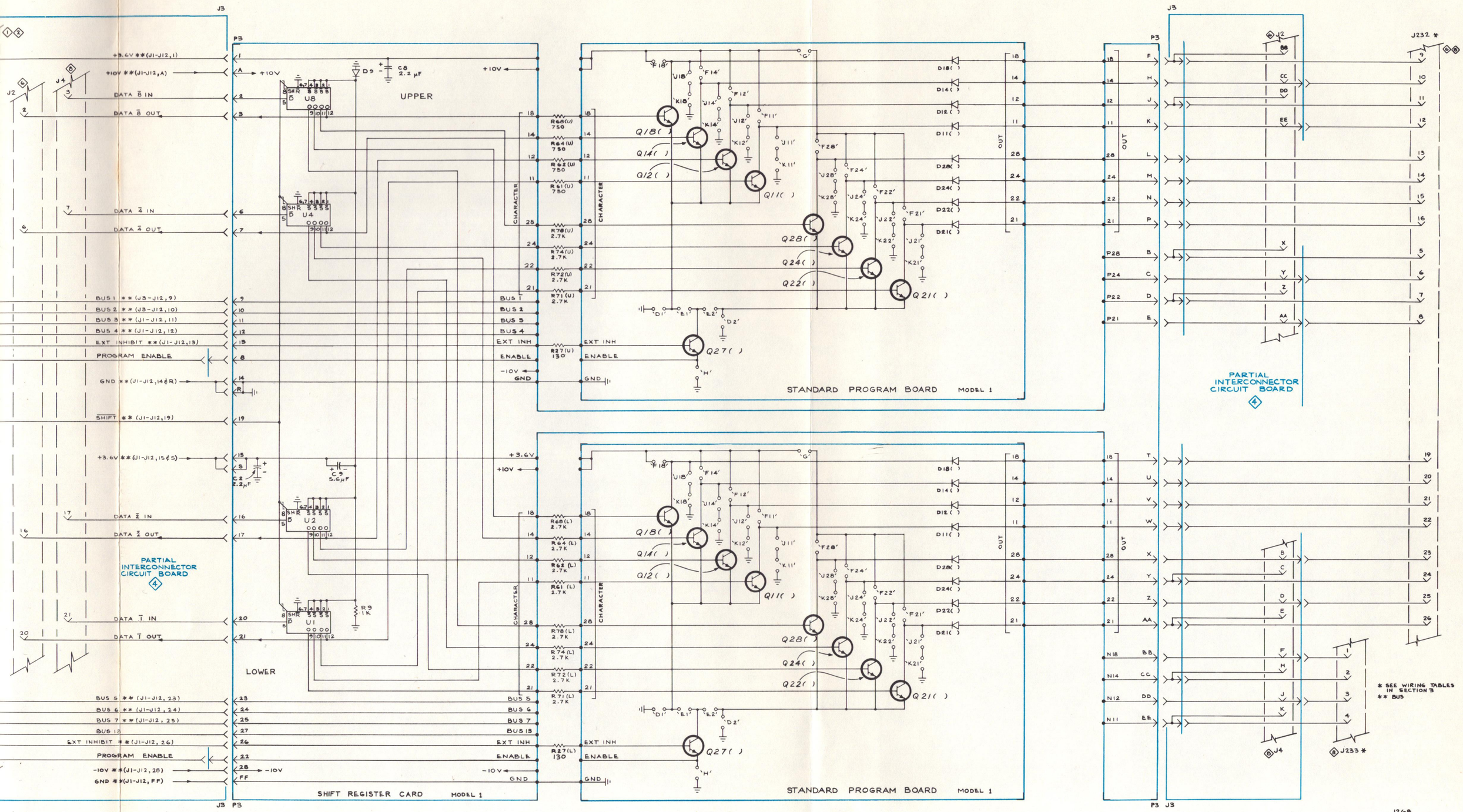
P2 PROGRAM ASSEMBLY CHAR 53-56 (OR 101-104) 6

1268

P2 PROGRAM ASSEMBLY CHAR 53-56 (OR 101-104) 6



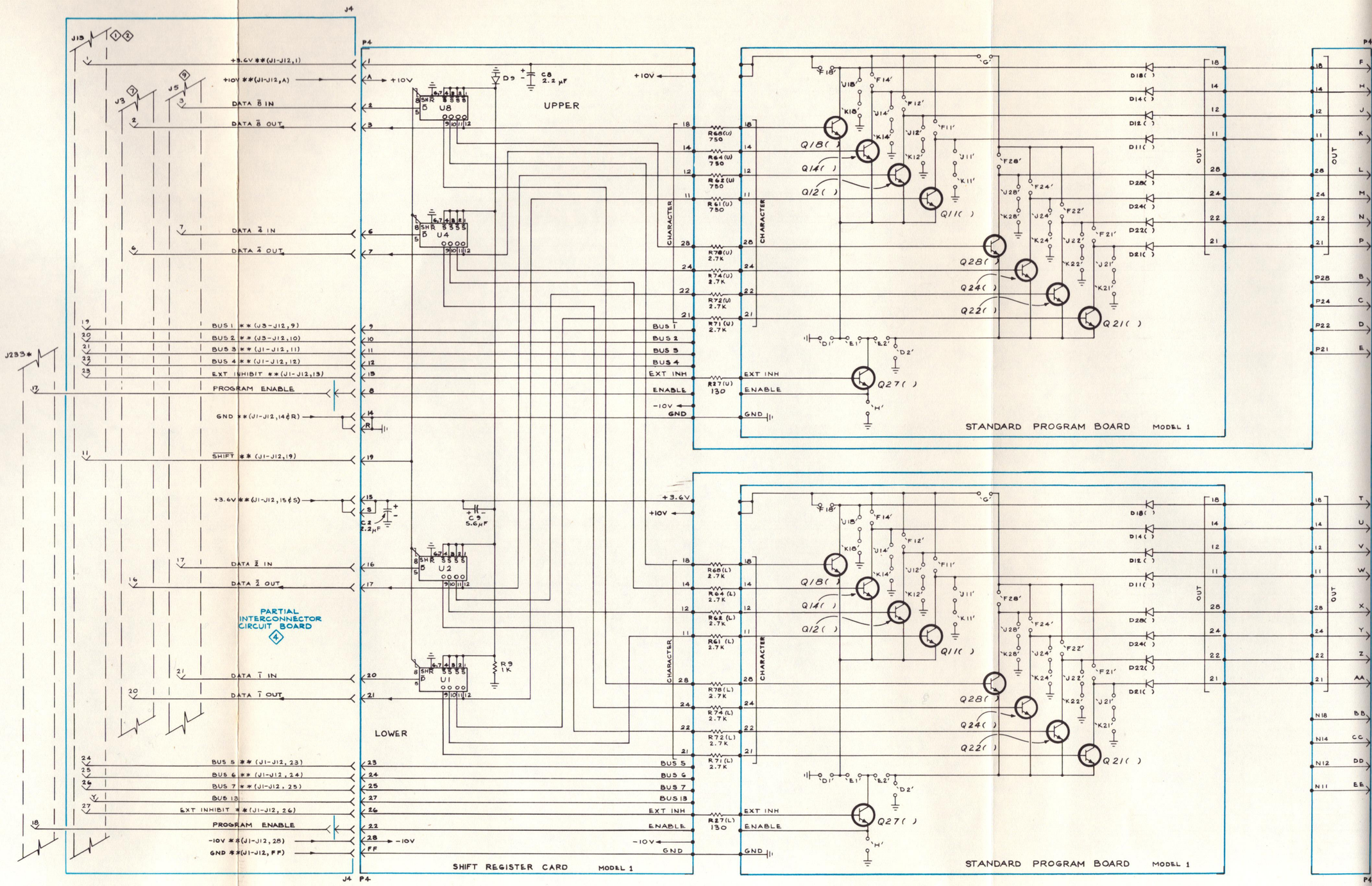
TYPE R250 AUXILIARY PROGRAM UNIT



TYPE R250 AUXILIARY PROGRAM UNIT

A

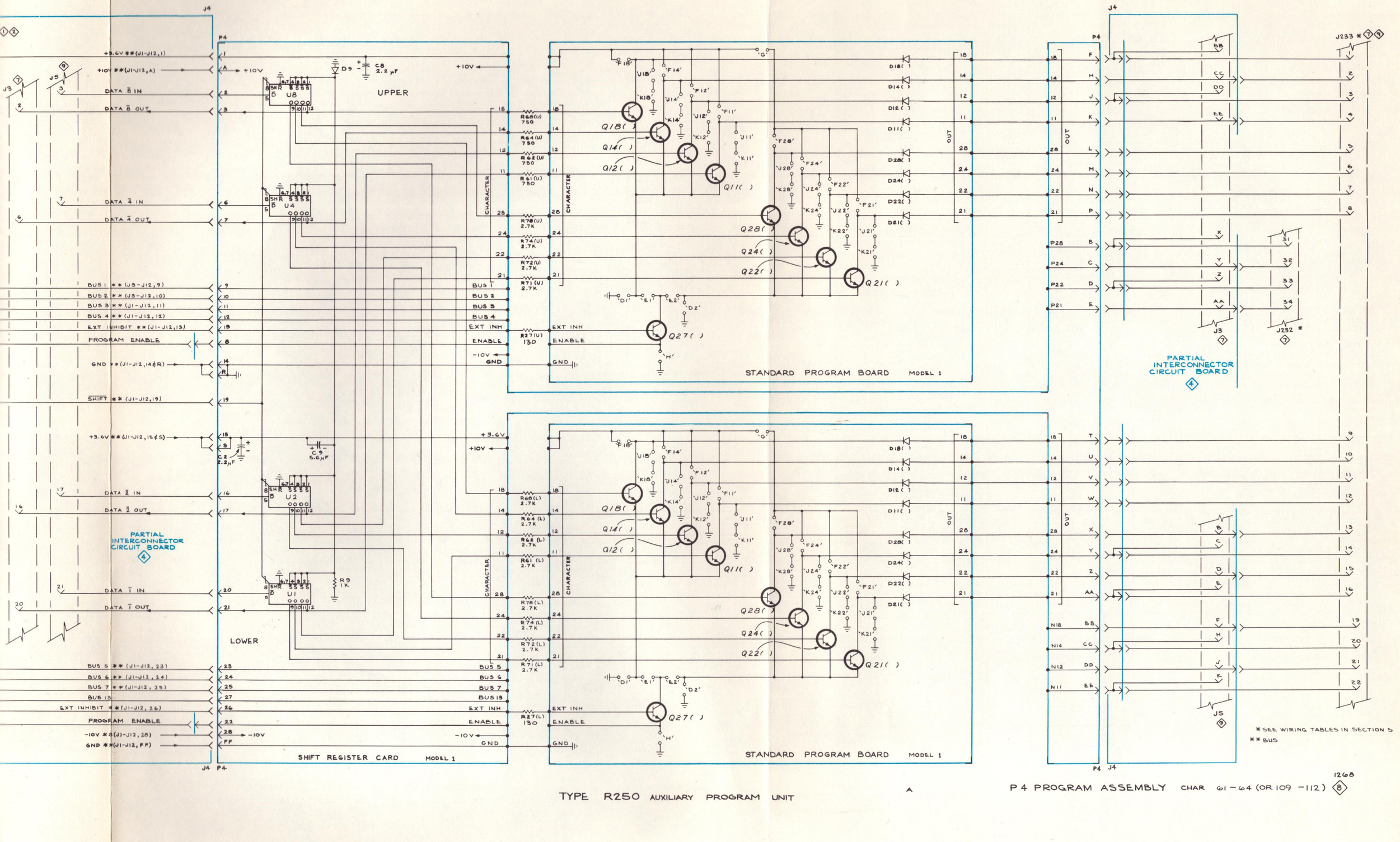
P3 PROGRAM ASSEMBLY CHAR 57 - 60 (OR 105 - 108) 7 1268



TYPE R250 AUXILIARY PROGRAM UNIT

A

P 4 PROGRAM

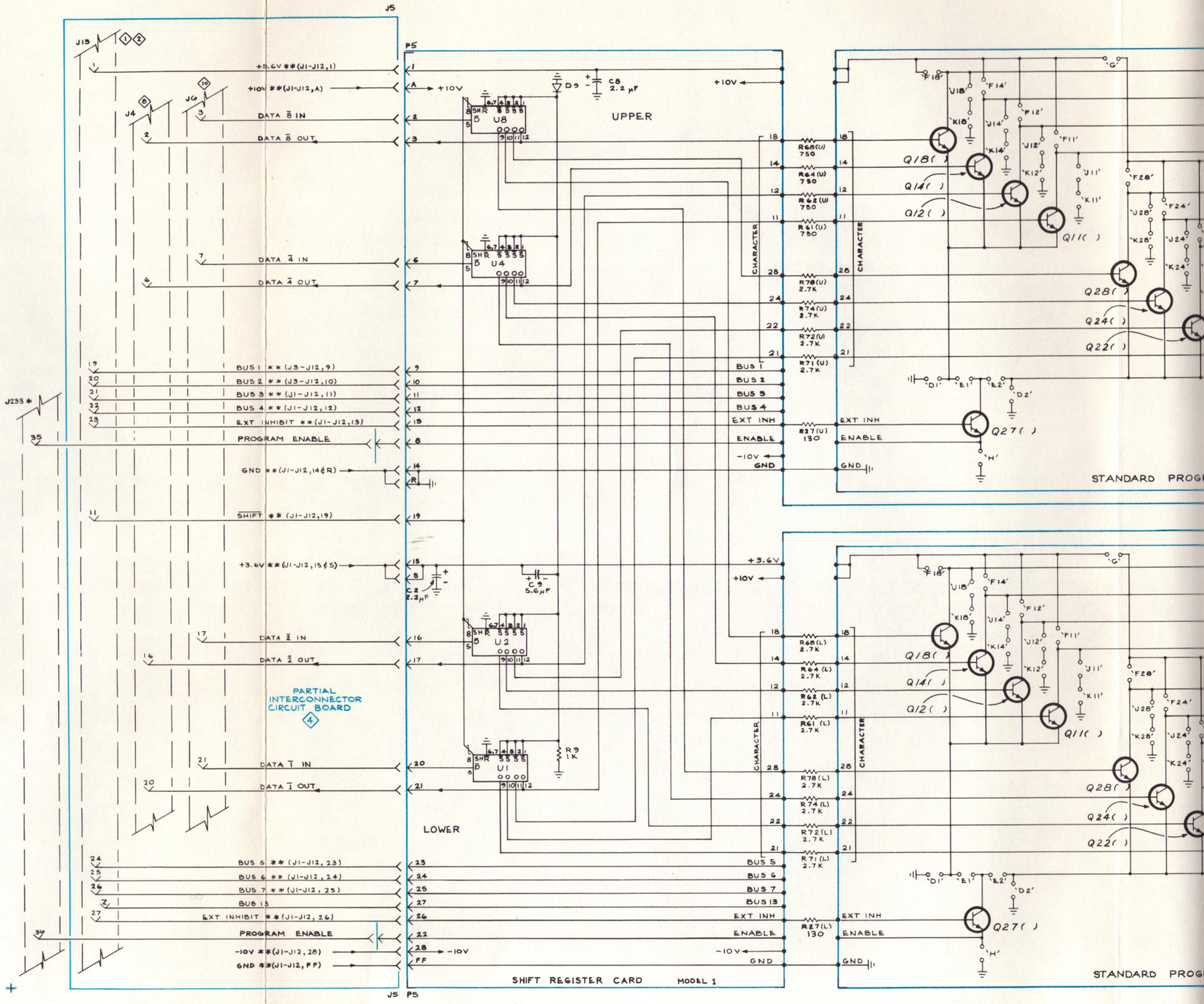


TYPE R250 AUXILIARY PROGRAM UNIT

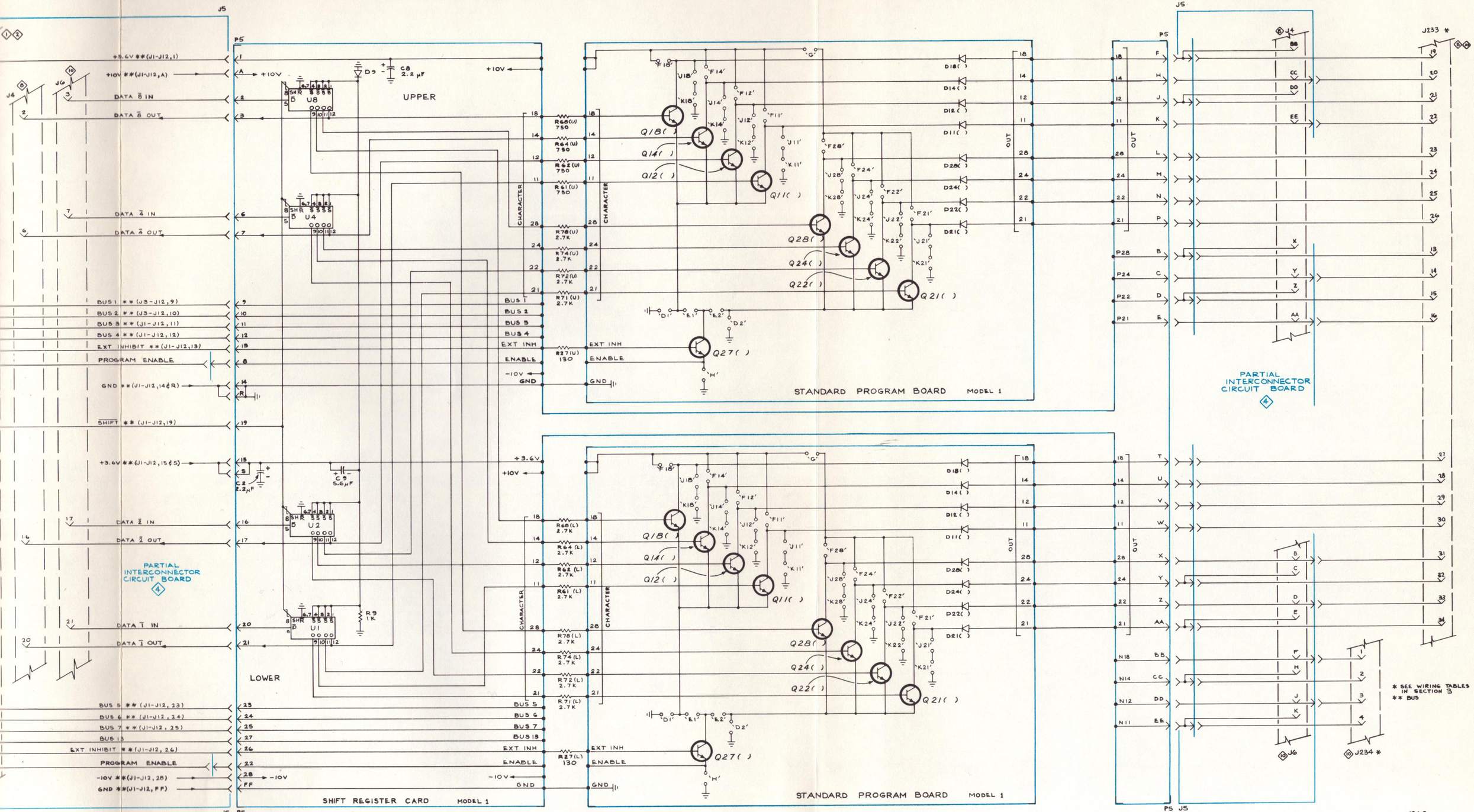
P4 PROGRAM ASSEMBLY CHAR 61-64 (OR 109-112) 8

1268

P4 PROGRAM ASSEMBLY CHAR 61-64 (OR 109-112) 8



TYPE R250 AUXILIARY PROGRAM UNIT

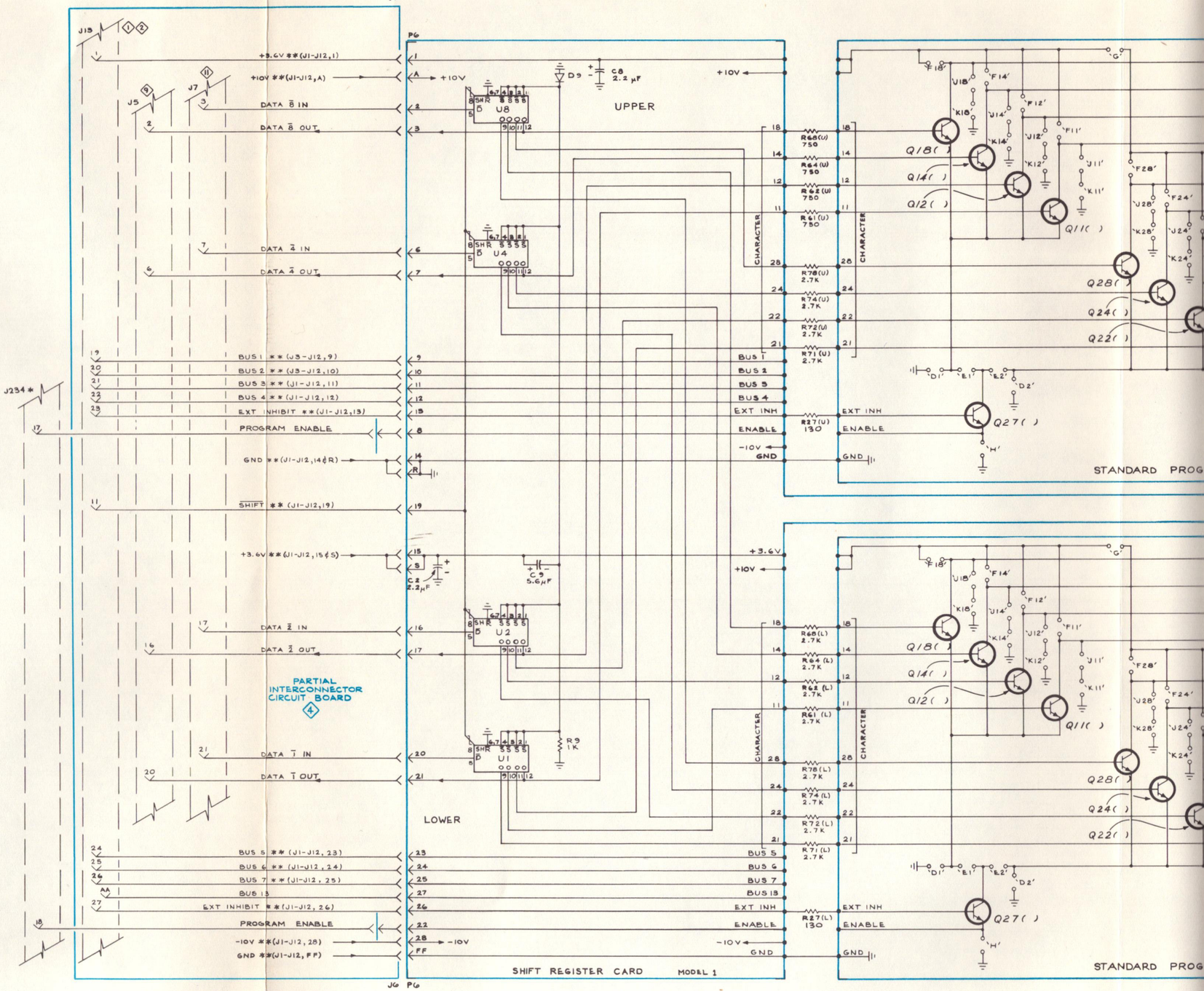


TYPE R250 AUXILIARY PROGRAM UNIT

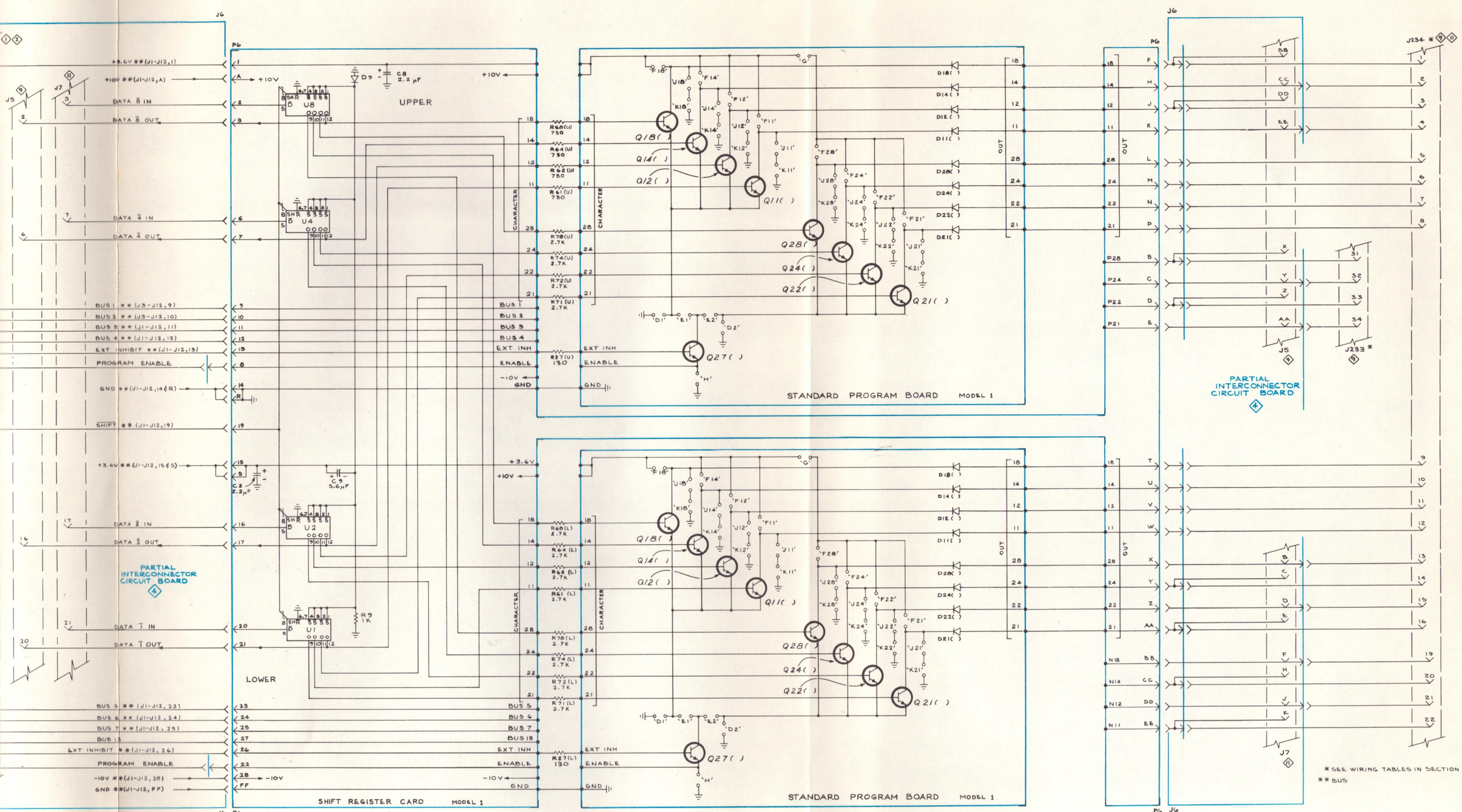
A

P5 PROGRAM ASSEMBLY CHAR 65 - 68 (OR 113 - 116) 9

1268



TYPE R250 AUXILIARY PROGRAM UNIT

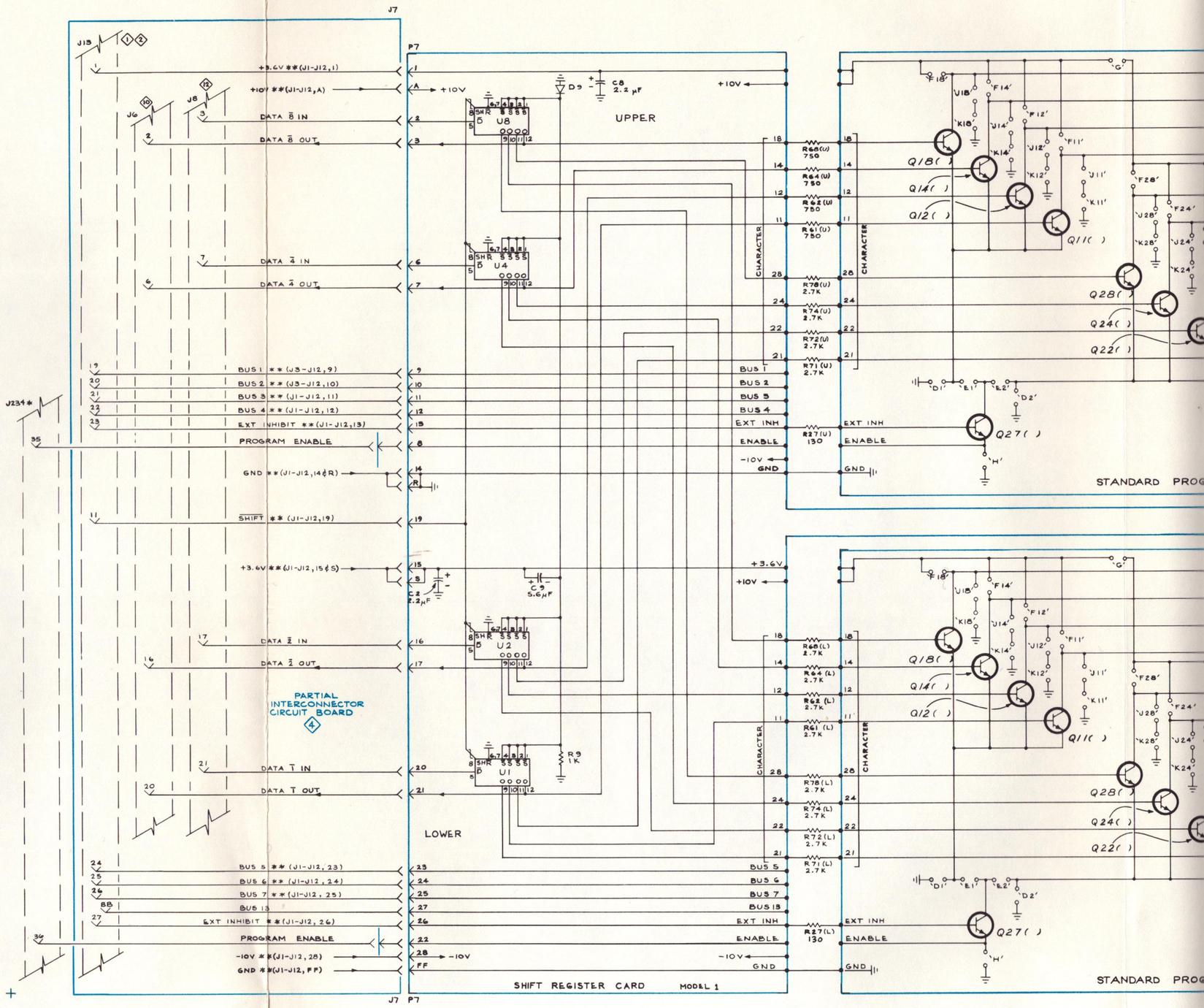


TYPE R250 AUXILIARY PROGRAM UNIT

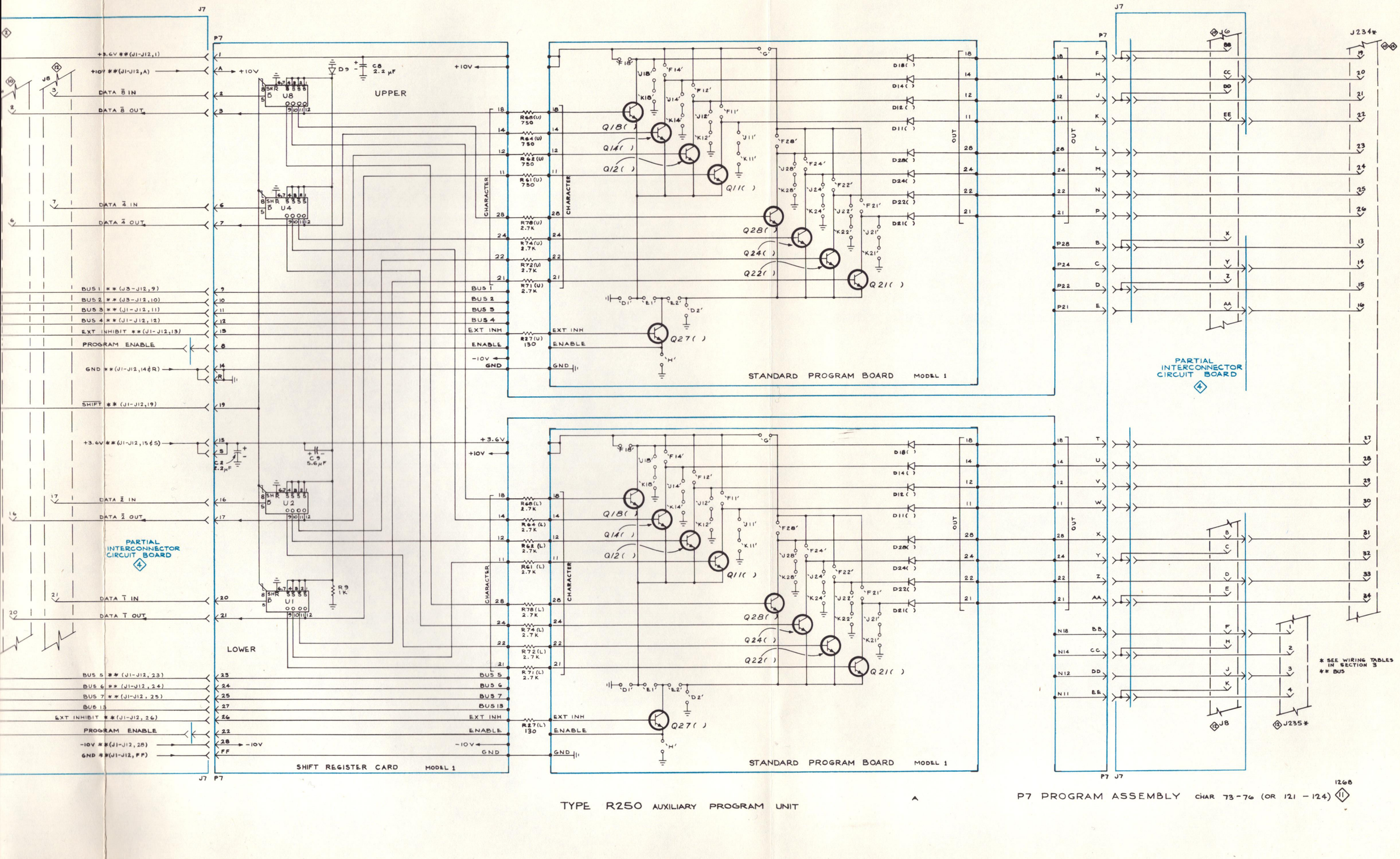
A

P6 PROGRAM ASSEMBLY CHAR 69 – 72 (OR 117 –120) 10

1268



TYPE R250 AUXILIARY PROGRAM UNIT

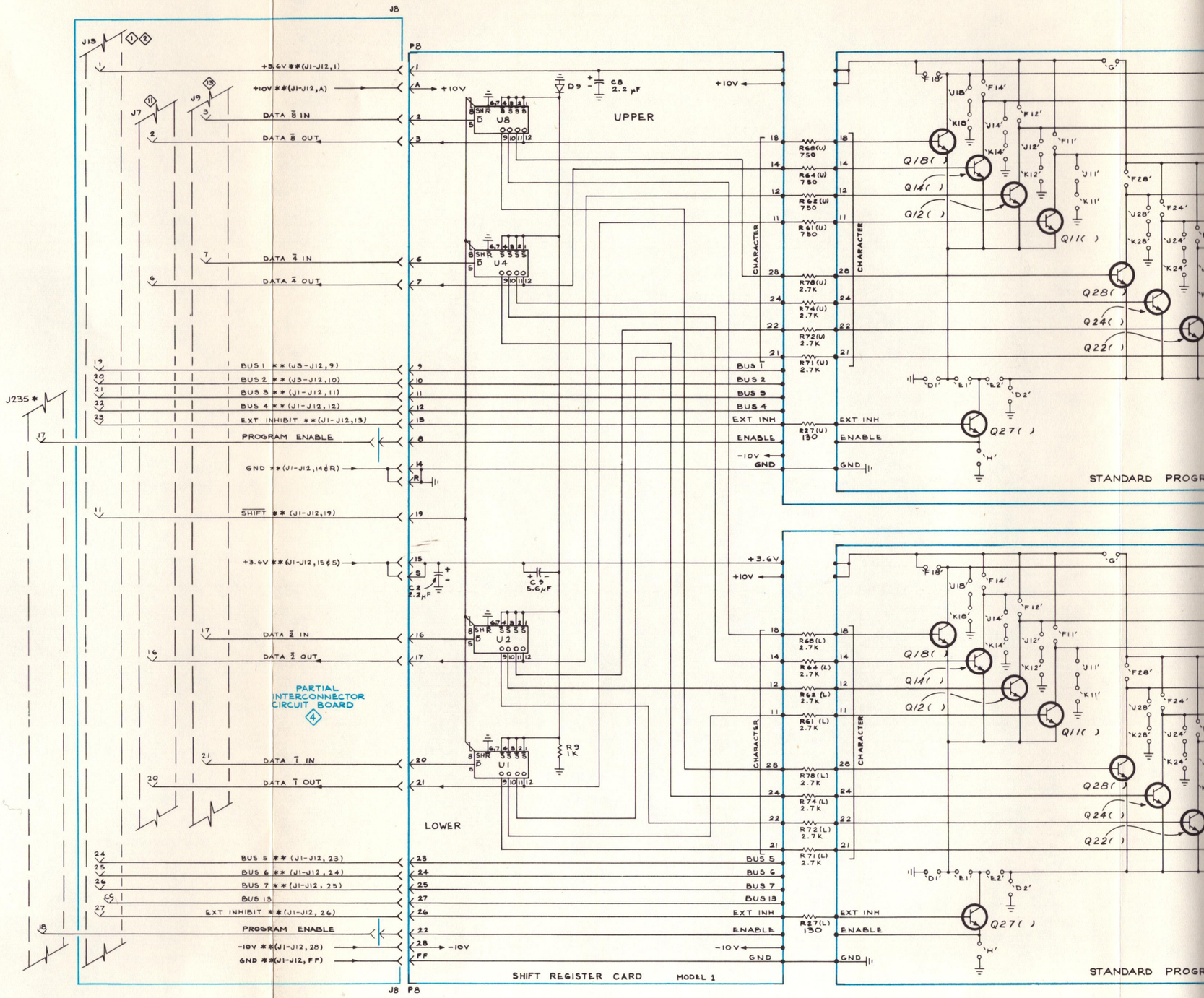


TYPE R250 AUXILIARY PROGRAM UNIT

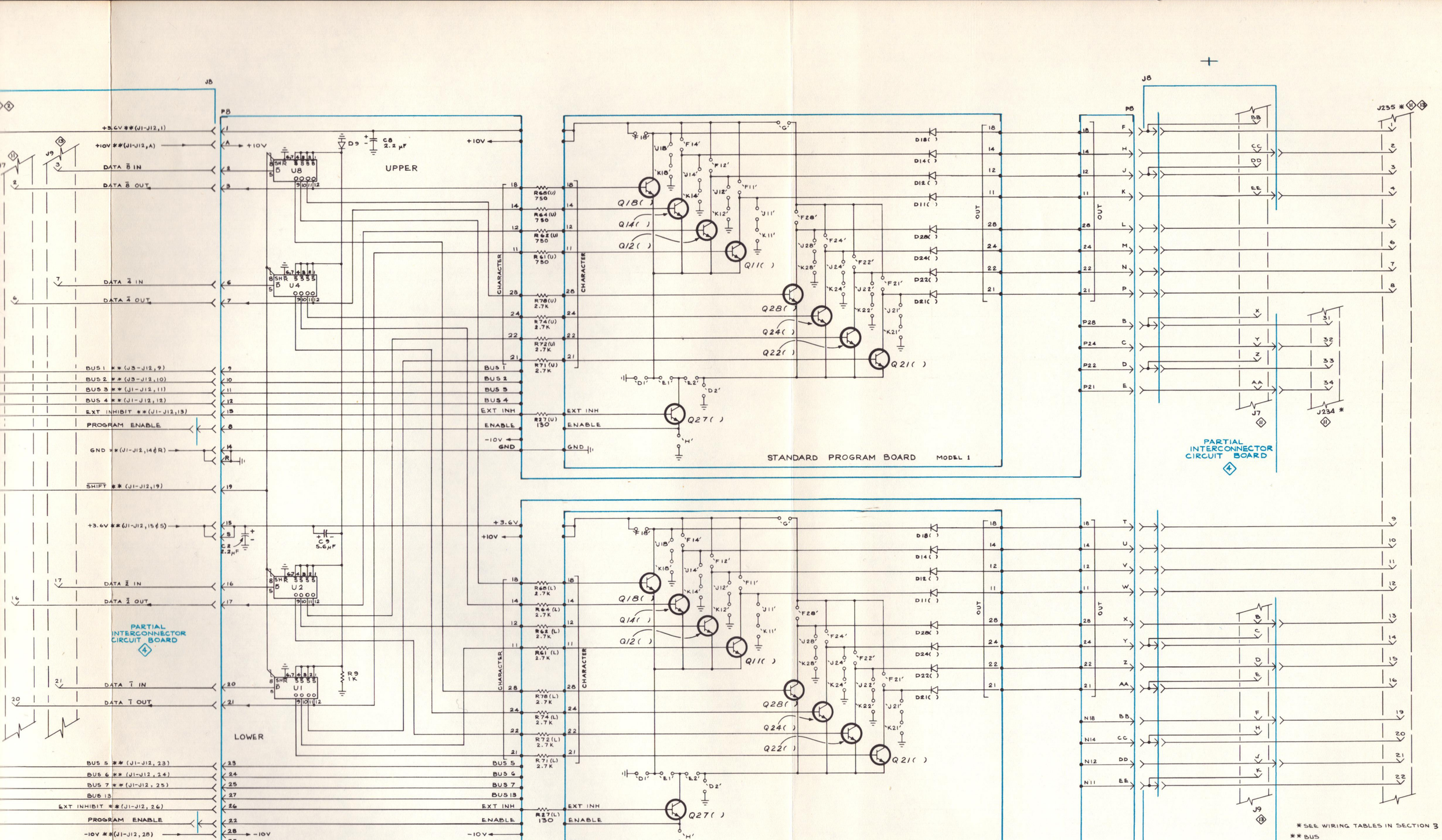
A

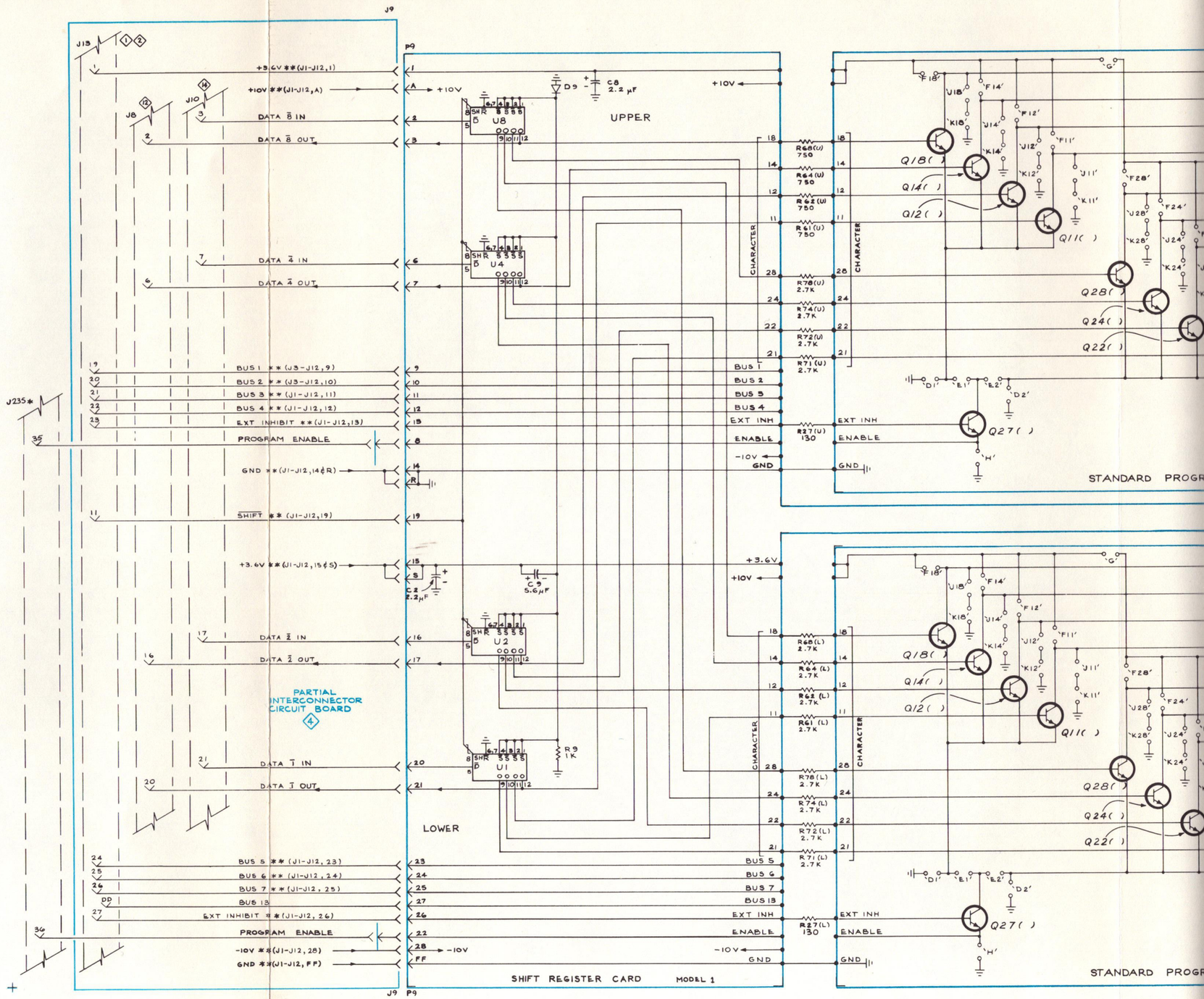
P7 PROGRAM ASSEMBLY CHAR 73-76 (OR 121 - 124) 11

1268

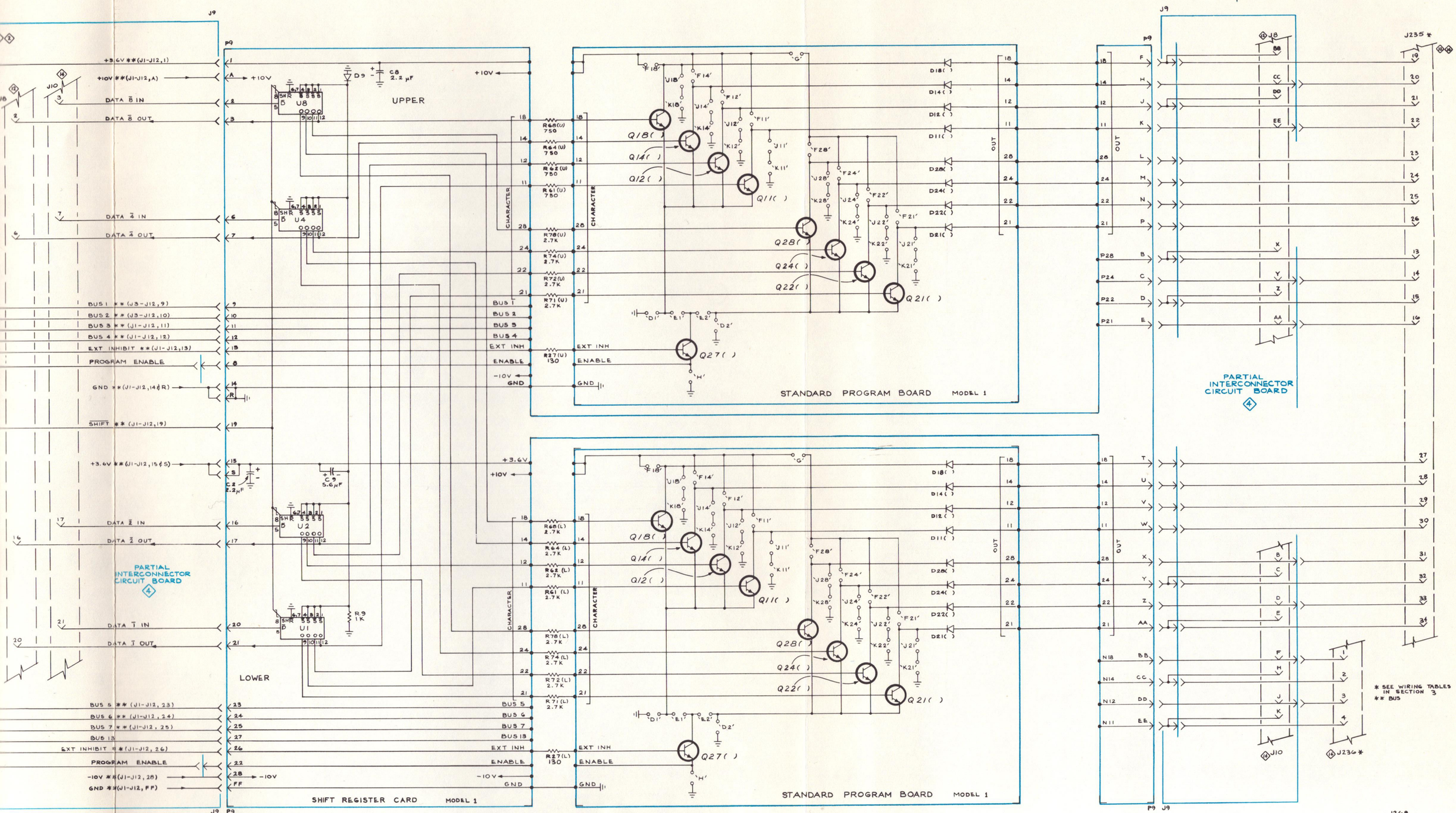


TYPE R250 AUXILIARY PROGRAM UNIT


J8
P8
+5.6V **(J1-J12,1)
+10V **(J1-J12,A)
DATA $\overline{B}$ IN
DATA $\overline{B}$ OUT
DATA $\overline{A}$ IN
DATA $\overline{A}$ OUT
BUS 1 ** (J3-J12,9)
BUS 2 ** (J3-J12,10)
BUS 3 ** (J1-J12,11)
BUS 4 ** (J1-J12,12)
EXT INHIBIT **(J1-J12,13)
PROGRAM ENABLE
GND **(J1-J12,14 & R)
$\overline{SHIFT}$ ** (J1-J12,19)
+3.6V **(J1-J12,15 & S)
DATA $\overline{Z}$ IN
DATA $\overline{Z}$ OUT
DATA $\overline{Y}$ IN
DATA $\overline{Y}$ OUT
BUS 5 ** (J1-J12,23)
BUS 6 ** (J1-J12,24)
BUS 7 ** (J1-J12,25)
BUS 13
EXT INHIBIT **(J1-J12,26)
PROGRAM ENABLE
-10V **(J1-J12,28)
GND **(J1-J12,FF)
PARTIAL INTERCONNECTOR CIRCUIT BOARD
4
UPPER
LOWER
+10V
D9
C8 2.2 μF
U8
U4
U2
U1
C9 5.6μF
C2 2.2μF
R9 1K
R68(U) 750
R64(U) 750
R62(U) 750
R61(U) 750
R78(U) 2.7K
R74(U) 2.7K
R72(U) 2.7K
R71(U) 2.7K
R68(L) 2.7K
R64(L) 2.7K
R62(L) 2.7K
R61(L) 2.7K
R78(L) 2.7K
R74(L) 2.7K
R72(L) 2.7K
R71(L) 2.7K
R27(U) 130
R27(L) 130
CHARACTER
BUS 1
BUS 2
BUS 3
BUS 4
EXT INH
ENABLE
-10V
GND
+3.6V
BUS 5
BUS 6
BUS 7
BUS 13
Q18( )
Q14( )
Q12( )
Q11( )
Q28( )
Q24( )
Q22( )
Q21( )
Q27( )
D18( )
D14( )
D12( )
D11( )
D28( )
D24( )
D22( )
D21( )
OUT
STANDARD PROGRAM BOARD MODEL 1
SHIFT REGISTER CARD MODEL 1
J235 *
J234 *
J7
J9
PARTIAL INTERCONNECTOR CIRCUIT BOARD
4
* SEE WIRING TABLES IN SECTION 3
** BUS
P8 PROGRAM ASSEMBLY CHAR 77 – 80 (OR 125 – 128)
12
1268
TYPE R250 AUXILIARY PROGRAM UNIT
A
P8 PROGRAM ASSEMBLY - CHAR 77-80 (OR 125-128)
12



TYPE R250 AUXILIARY PROGRAM UNIT

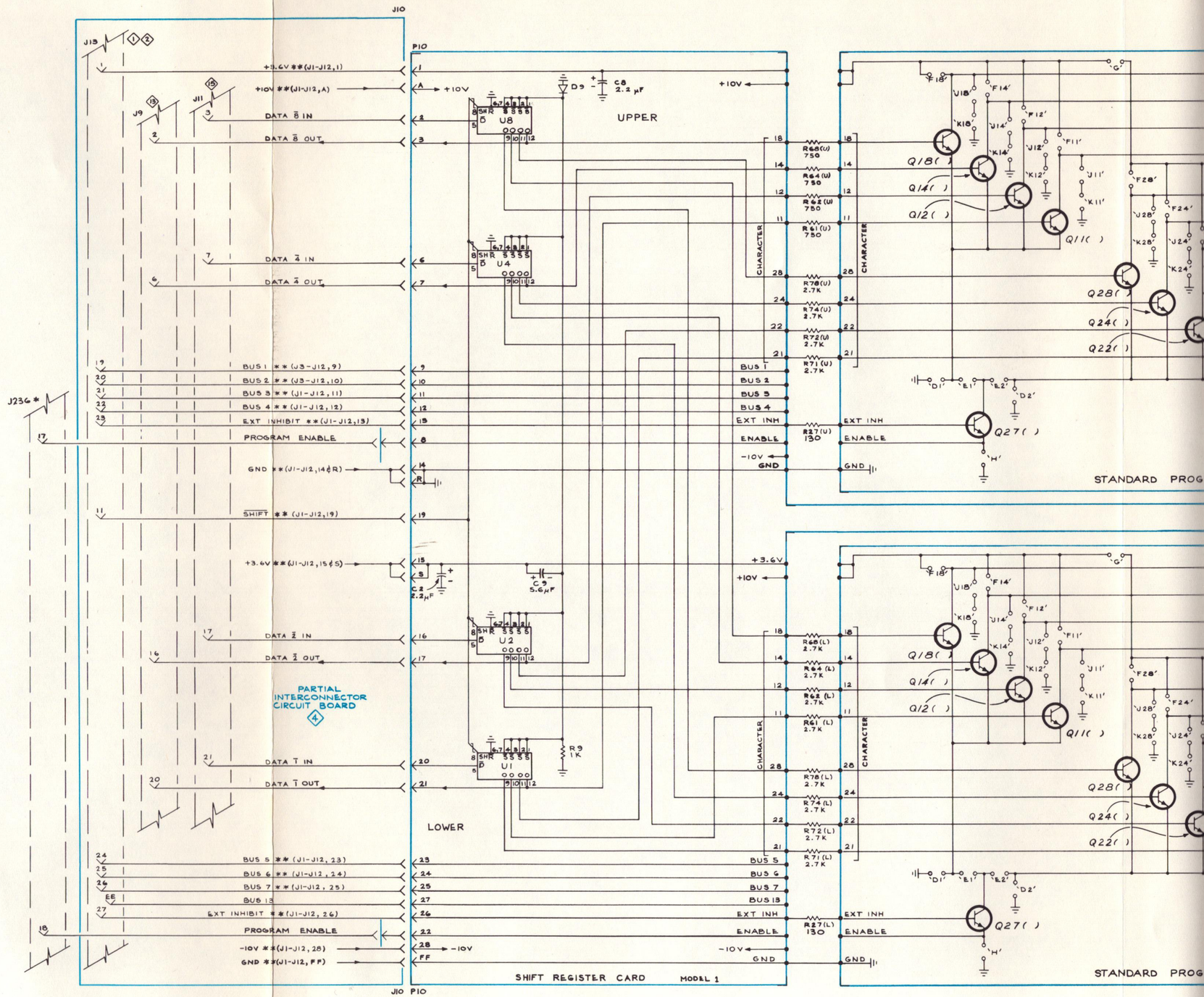


TYPE R250 AUXILIARY PROGRAM UNIT

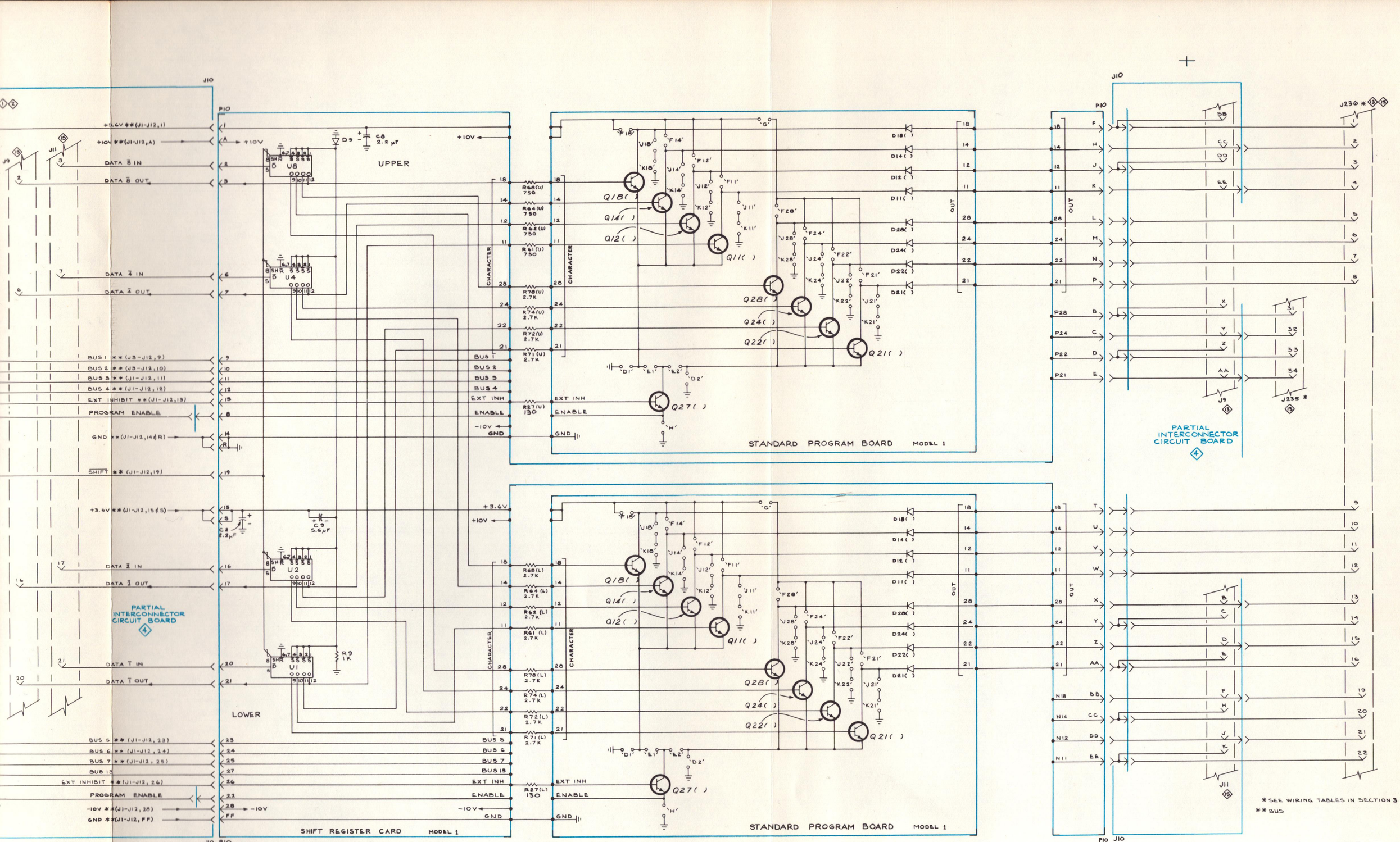
A

P9 PROGRAM ASSEMBLY CHAR 81 - 84 (OR 129 - 132) 13

1268



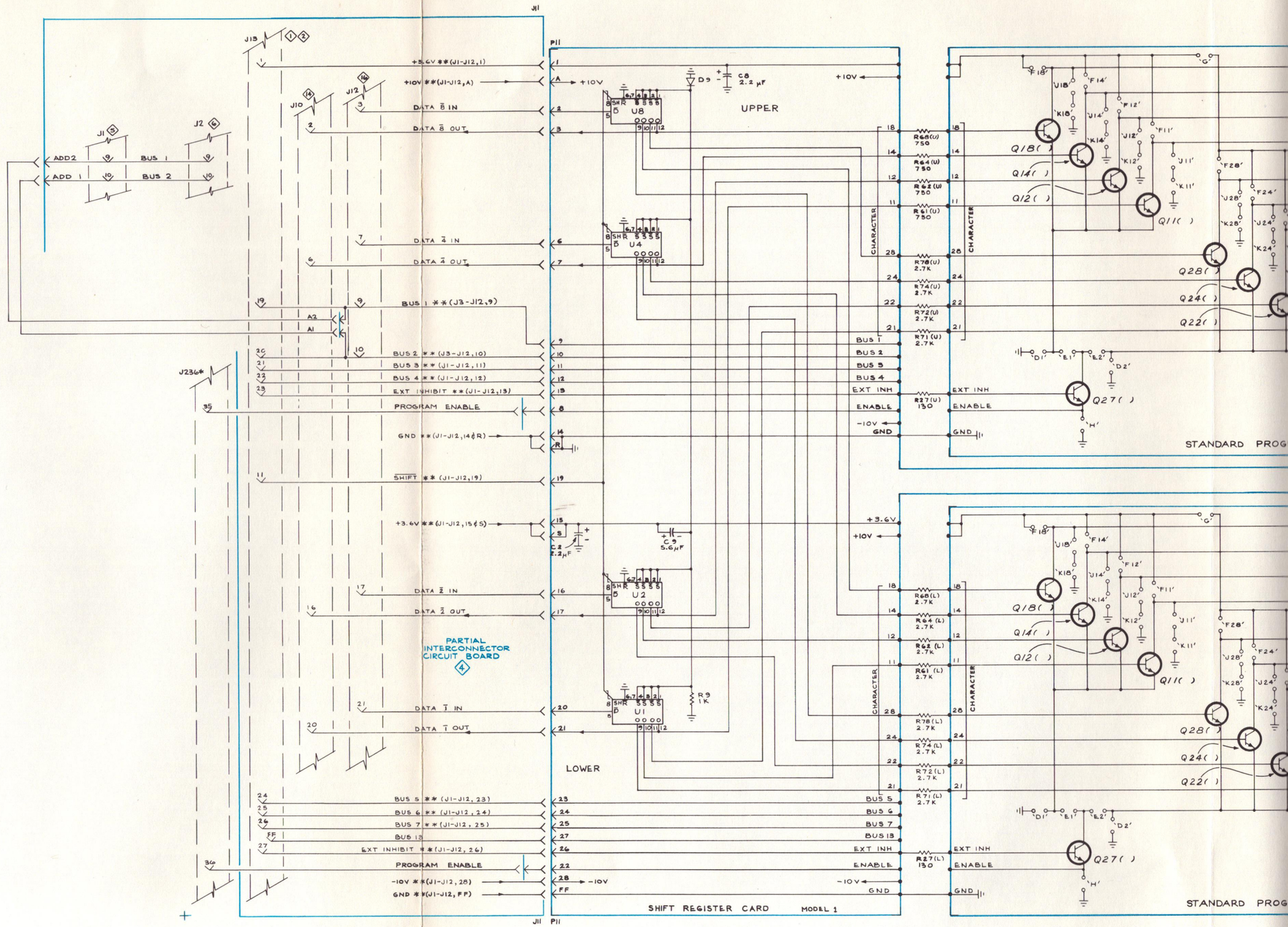
TYPE R250 AUXILIARY PROGRAM UNIT



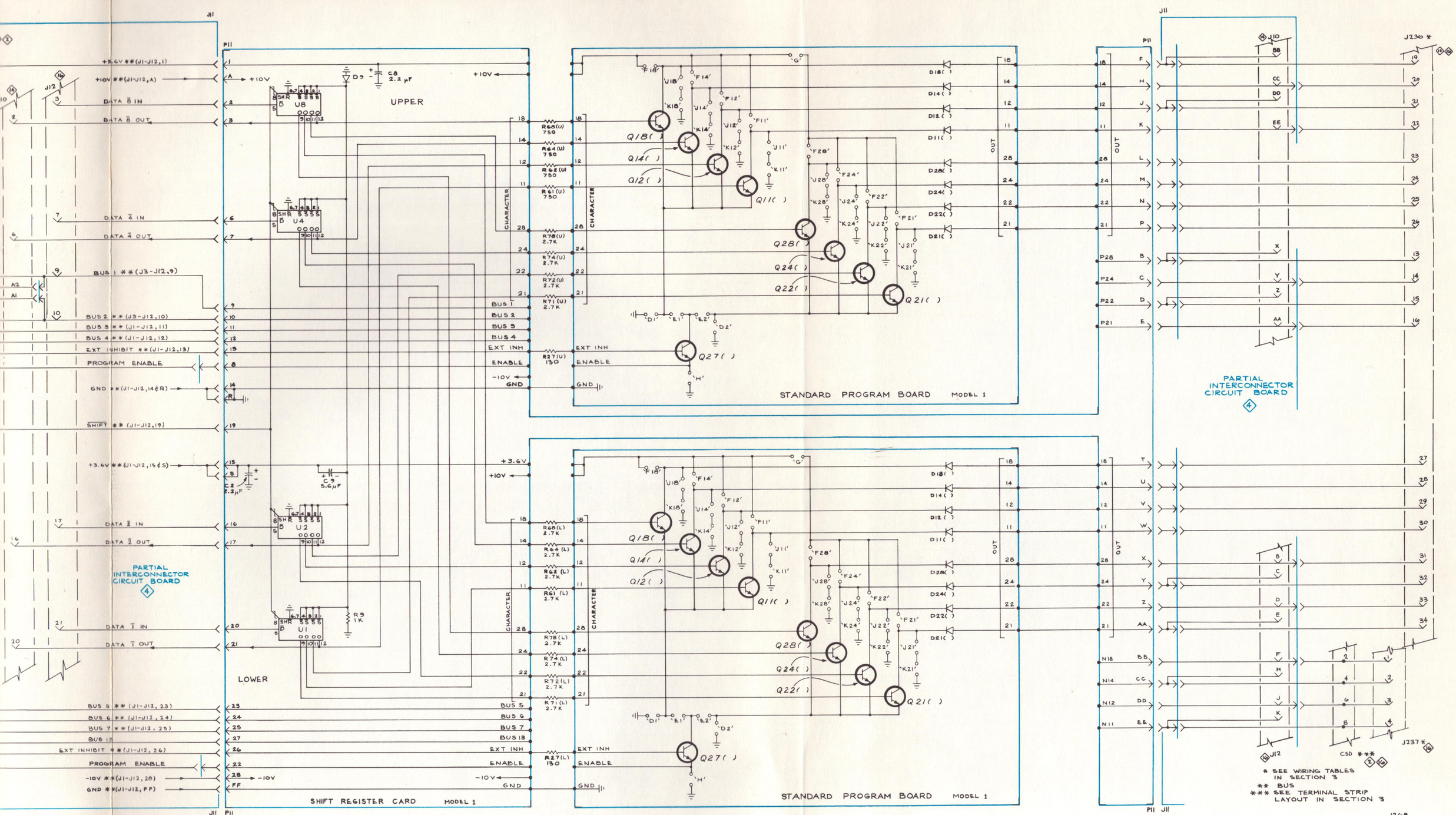
TYPE R250 AUXILIARY PROGRAM UNIT

P10 PROGRAM ASSEMBLY CHAR 85 – 88 (OR 133 – 136) 14

1268



TYPE R250 AUXILIARY PROGRAM UNIT



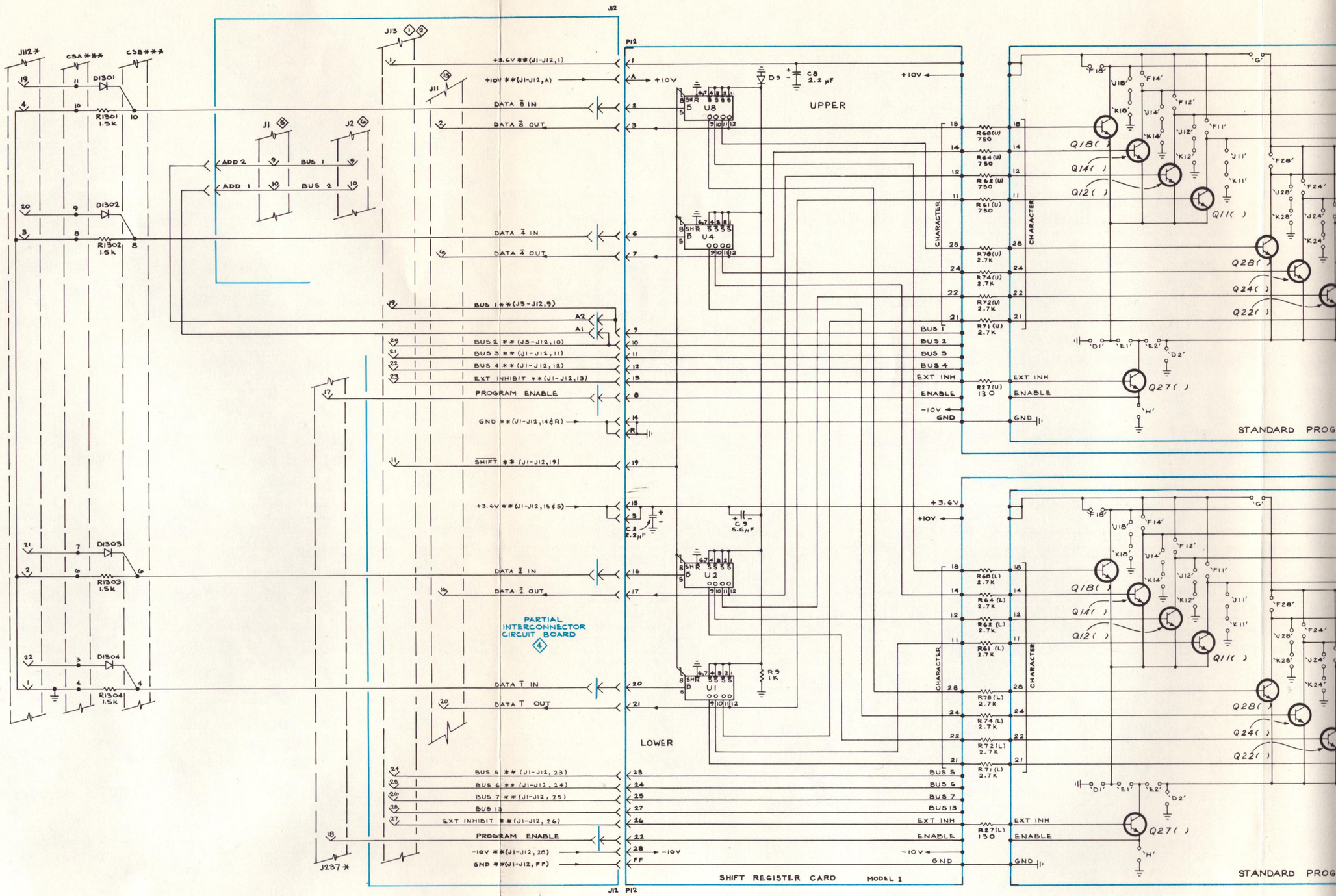
TYPE R250 AUXILIARY PROGRAM UNIT

A

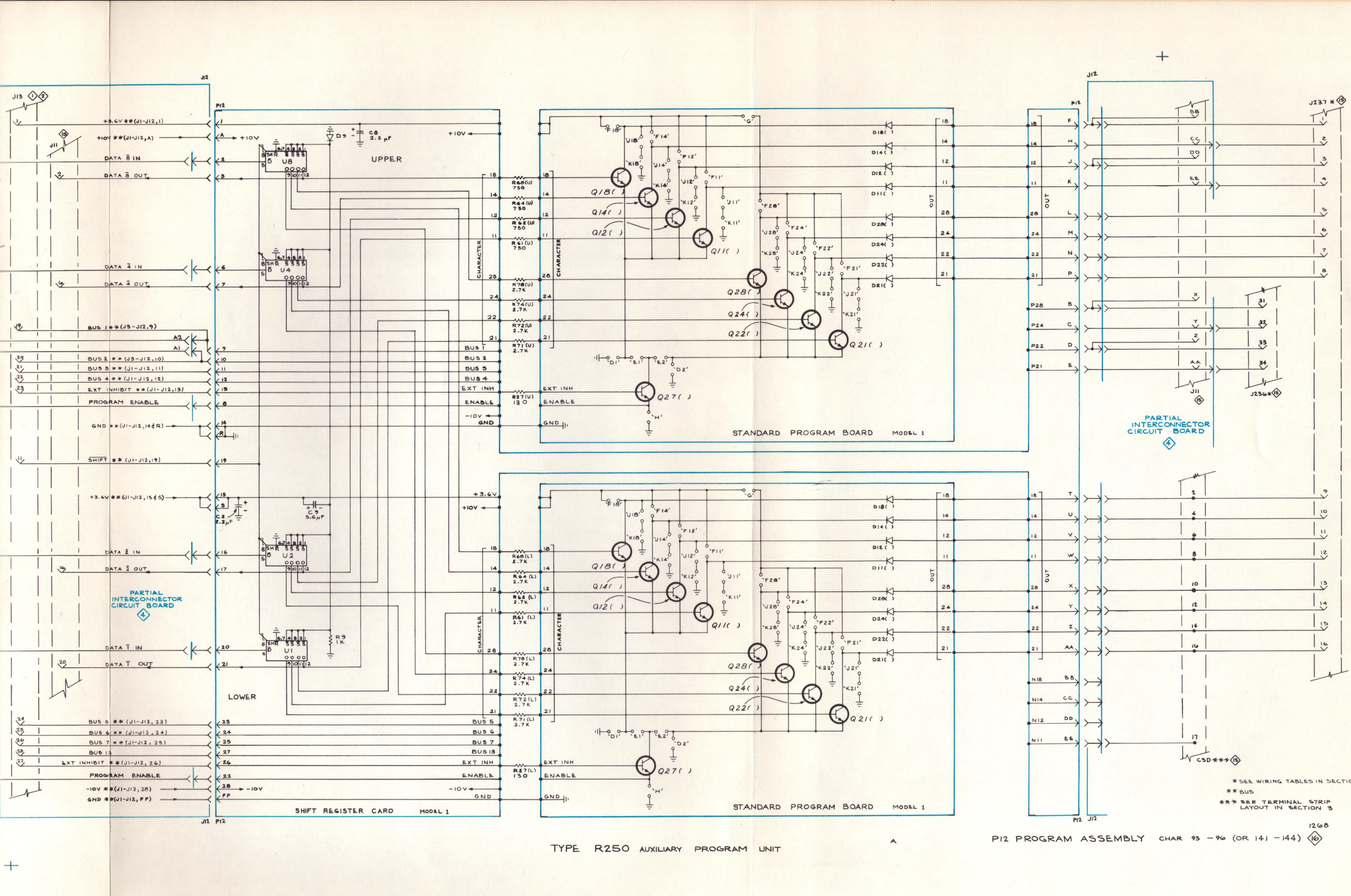
P11 PROGRAM ASSEMBLY CHAR 89 - 92 (OR 137 - 140) 15

1268

P11 PROGRAM ASSEMBLY CHAR 89-92 (OR 137-140) 15



TYPE R250 AUXILIARY PROGRAM UNIT



TYPE R250 AUXILIARY PROGRAM UNIT

A

P12 PROGRAM ASSEMBLY CHAR 93 – 96 (OR 141 – 144) 16

12-68

P12 PROGRAM ASSEMBLY CHAR 93-96 (OR 141-144) 16

FIG. 1 FRONT & FRONT FRAME PARTS

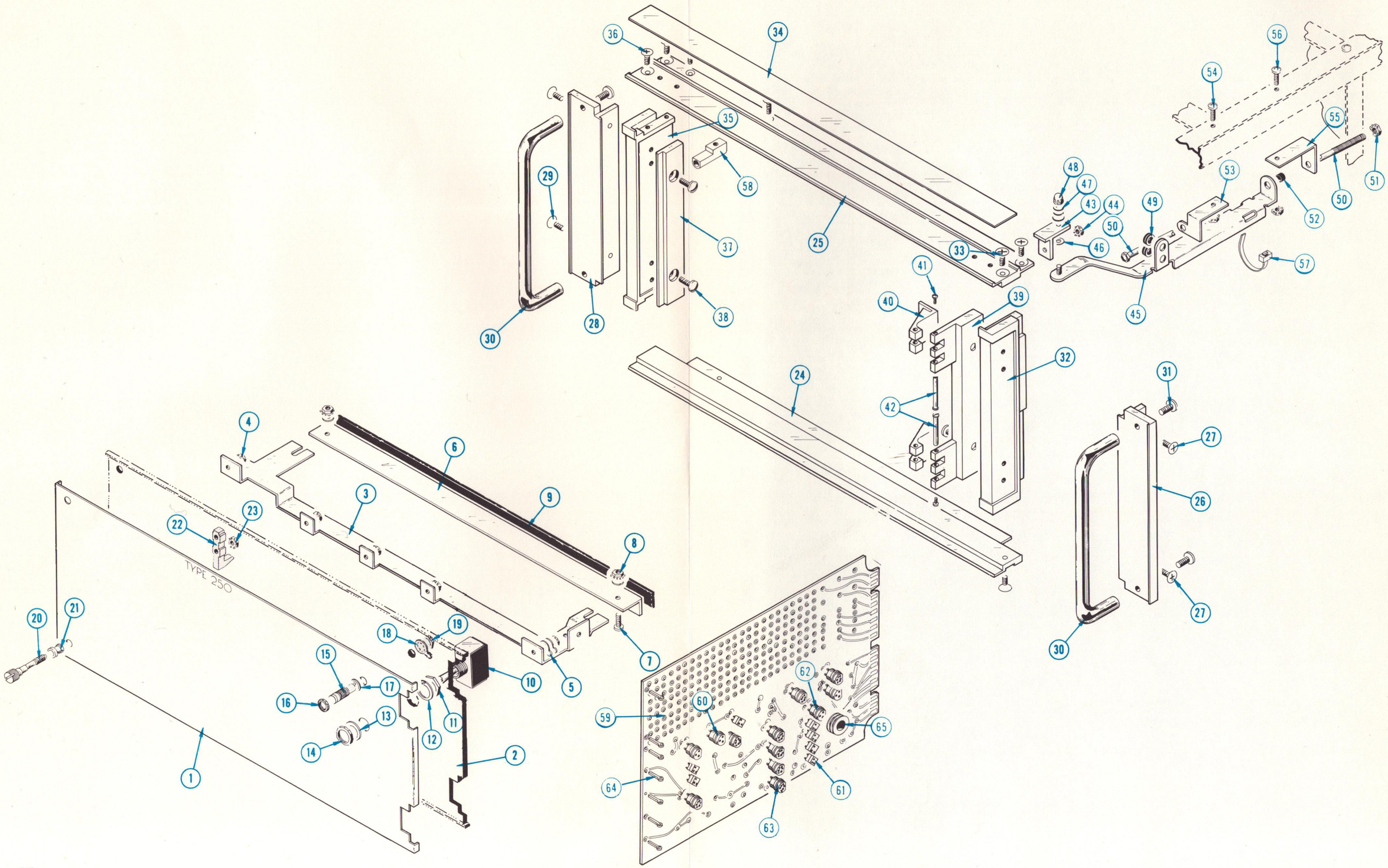
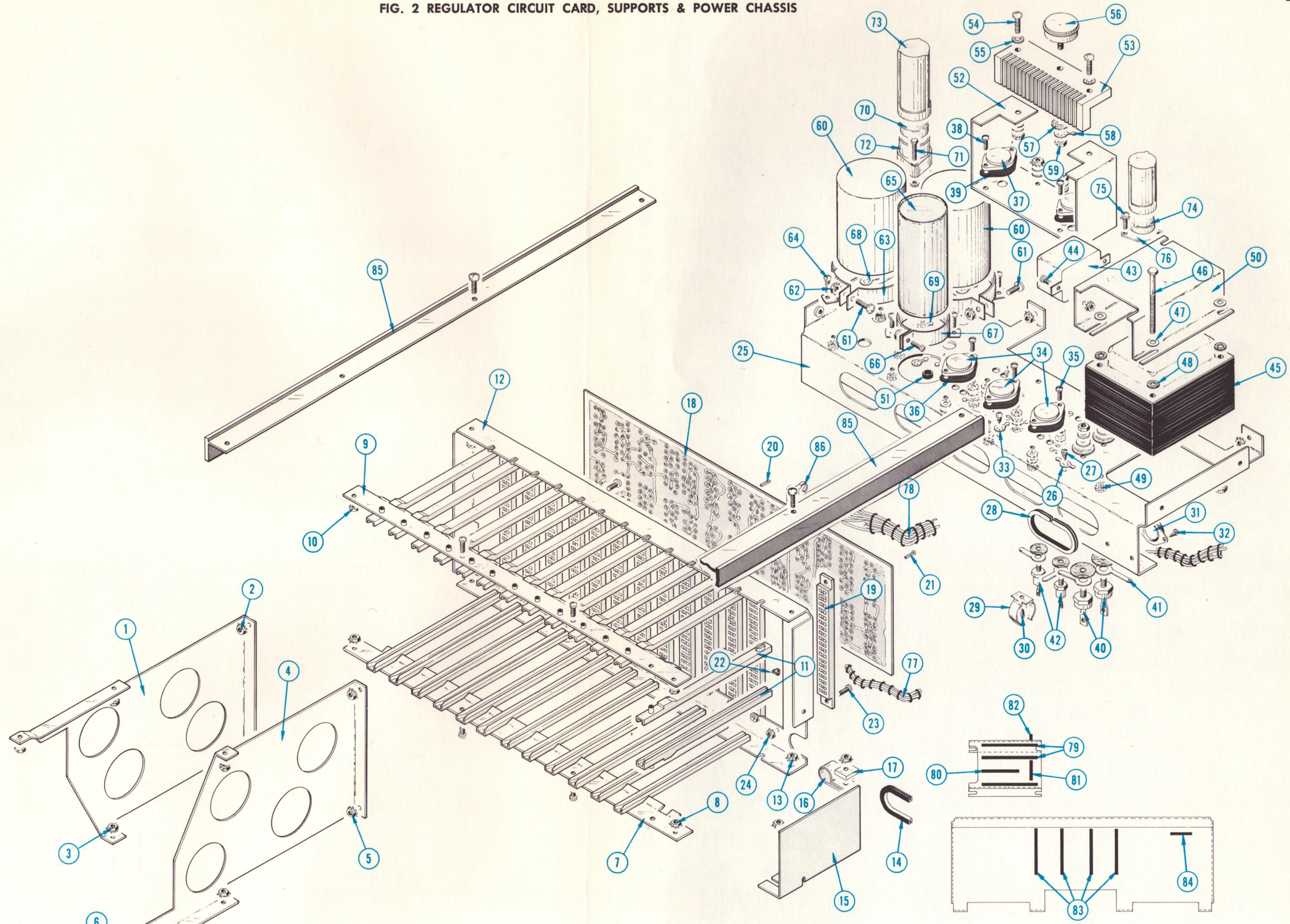


FIG. 2 REGULATOR CIRCUIT CARD, SUPPORTS & POWER CHASSIS



TYPE R250 AUXILIARY PROGRAM UNIT

FIG. 2

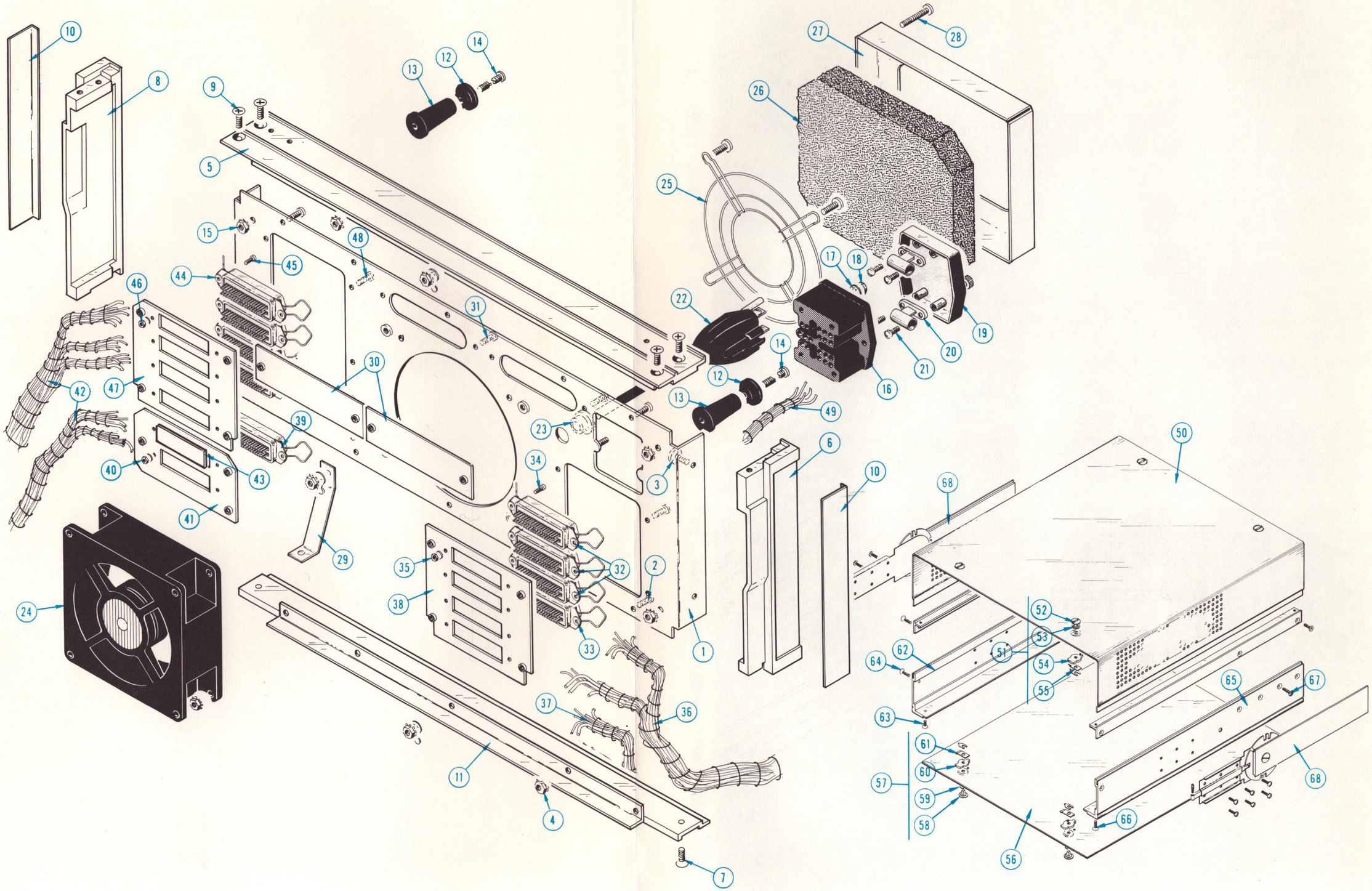

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FIG. 4 STANDARD ACCESSORIES

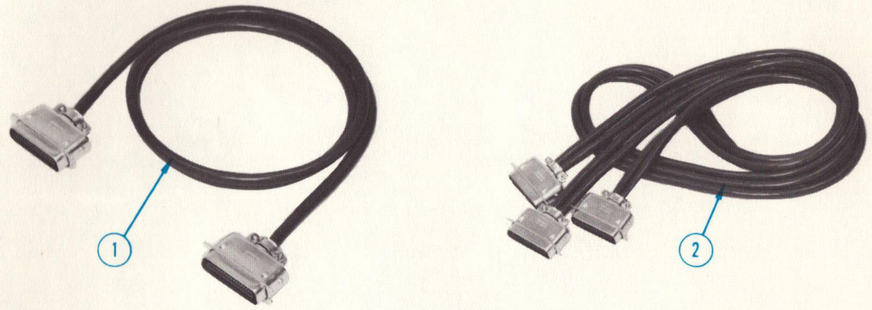


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
4-1	012-0134-00			1	CABLE, interconnecting (240 to 250)
	- - - - - -			-	or:
-2	012-0135-00			1	CABLE, interconnecting (240 to 250 to 250)
	351-0086-00			1	TRACK, slide, stationary and intersection, pair (not shown)
	016-0097-00			1	RACKMOUNT KIT, rear support (not shown)
	016-0099-00			1	HARDWARE KIT, rackmounting (not shown)
	070-0886-00			1	TABLET, test format (characters 49 thru 96) (not shown)
	- - - - - -			-	or:
	070-0887-00			1	TABLET, test format (characters 97 thru 144) (not shown)
	070-0748-00			2	MANUAL, instruction (not shown)

OPTIONAL ACCESSORIES (not shown)

	020-0020-00			1	CARD, register and hardware
	020-0021-00			1	BOARD, standard program
	020-0022-00			1	BOARD, conductance program
	020-0023-00			1	BOARD, resistance program
	012-0131-00			1	CABLE, interconnecting, 230 to 240 and 240 to 568
	012-0132-00			1	CABLE, interconnecting, 240 (J114)

SECTION 8
RACKMOUNT/BENCHMOUNT INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The Type R250 Auxiliary Program Unit is designed to be installed in a standard 19-inch wide rack which has Universal, EIA, RETMA or Western Electric hole spacing. Rackmounting instructions appear later in this section.

The Type R250 can be converted to a bench-mount model (Type 250) for operation on any flat surface, or for stacking with other instruments having the same cabinet design. Detailed conversion instructions follow.

CONVERTING FROM TYPE R250 TO TYPE 250

Removing Parts

Parts peculiar to the Type R250 must be removed from the Auxiliary Program Unit chassis before it can be converted to a bench-mount instrument (Type 250). These parts are shown in Fig. 8-1, and can be removed as follows:

1. Disconnect the Type R250 from the power source and remove the cables from the rear panel. Remove the unit from the rack and set it down on its bottom surface.

2. Lift the front and rear trim strips from the top of the chassis. Use a thin-bladed device to pry them up at one corner and then peel them off. Removal will bend them, but they can be straightened for later re-use.

3.[1] Loosen the four screws on the top dust cover and remove the cover.

4. Set the unit on its rear feet.

5. Unscrew the front-panel thumb screws and swing open the front panel.

6.[1] Remove circuit cards P1 through P4 and P10 through P13.

7.[1] Unscrew the two nuts holding the plastic shield and cable clamp to the bottom of the right side panel (as viewed from the front). Remove the plastic shield.

8.[1] Remove the six nuts, washers and screws from the mounting arm of the right chassis section assembly.

9.[1] Remove the nut and washers from the pivot screw while holding the pivot screw and chassis section assembly in place. Remove the pivot screw and chassis section assembly as a unit, holding it together tightly. Replace the washers and nut and hand-tighten the nut to hold the assembly together after removal.

10.[1] Replace the plastic shield, re-installing the cable clamp under the rear nut.

11.[1] Remove the left chassis section assembly, following the procedure described previously. The left side of the instrument, however, has no plastic shield or cable clamp to remove and replace.

12.[1] Replace the circuit cards in the instrument, then close and secure the front panel.

13. Remove the outermost screw from each of the four corners on the bottom of the chassis.

14.[1] Remove the angle brackets from the front corners of the chassis.

Save all parts that have been removed for possible later conversion back to a Type R250.

[1]For only temporary conversion to a bench-mount instrument (Type 250), this step may be omitted.

Parts Required

The following parts must be added to complete the conversion to a bench-mount instrument. Locations are shown in Fig. 8-2.

TABLE 8-1
Parts Found in the Type 250 Only

Qty.	Item	Tektronix Part No.	Figure Number
2 ea	Handle, carrying	367-0073-00	8-2
4 ea	Plate, plastic	386-1352-00	8-2
8 ea	Screw, 10-32 X 0.40 inch, FHS	213-0155-00	8-2
4 ea	Cover, handle end	200-0728-00	8-2
2 ea	Strip, trim, 0.995 X 6.45 inch	124-0189-00	8-2
2 ea	Foot, cabinet, front right and rear left	348-0096-01	8-2
2 ea	Foot, cabinet, front left and rear right	348-0098-01	8-2
5 ea	Screw, 10-32 X 5/8 inch, PHS	212-0509-00	8-2
4 ea	Pad, cabinet foot	348-0097-00	8-2
1 ea	Retainer, Flipstand	214-0846-01	8-2
1 ea	Flipstand, cabinet	348-0095-01	8-2

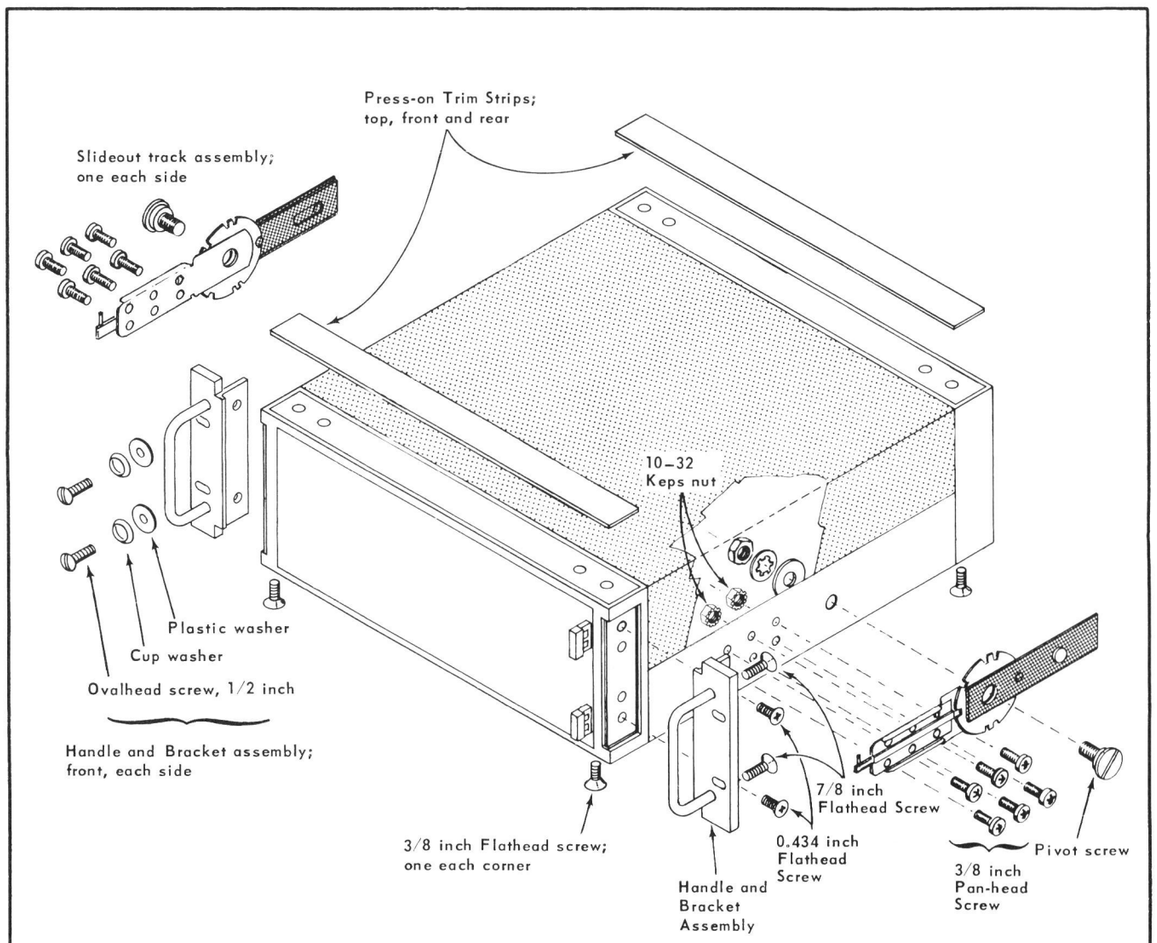


Fig. 8-1. Parts peculiar to the Type R250 chassis. See Figs. 8-4, 8-5, and 8-10 for rack attachment parts.

Installing Parts

1. Install the four feet, orienting them as shown in Fig. 8-2, then fully insert the four foot pads. Install the flipstand retainer, then spring the flipstand in place.

2.[1] Remove the protective strip from the back of a press-on trim strip (black) and install it on one front corner as shown. Engage the front edge first to ensure alignment, then press the entire strip firmly in place. Repeat at the other front corner.

3. Set the Auxiliary Program Unit on its bottom feet and install the top cover. Then place a plastic plate at each corner and a handle at each end of the instrument as shown. Center each plastic plate front-to-back in the frame recess (to permit installation of the end cover) before tightening the screws. Snap the plastic end covers in place. This completes the conversion.

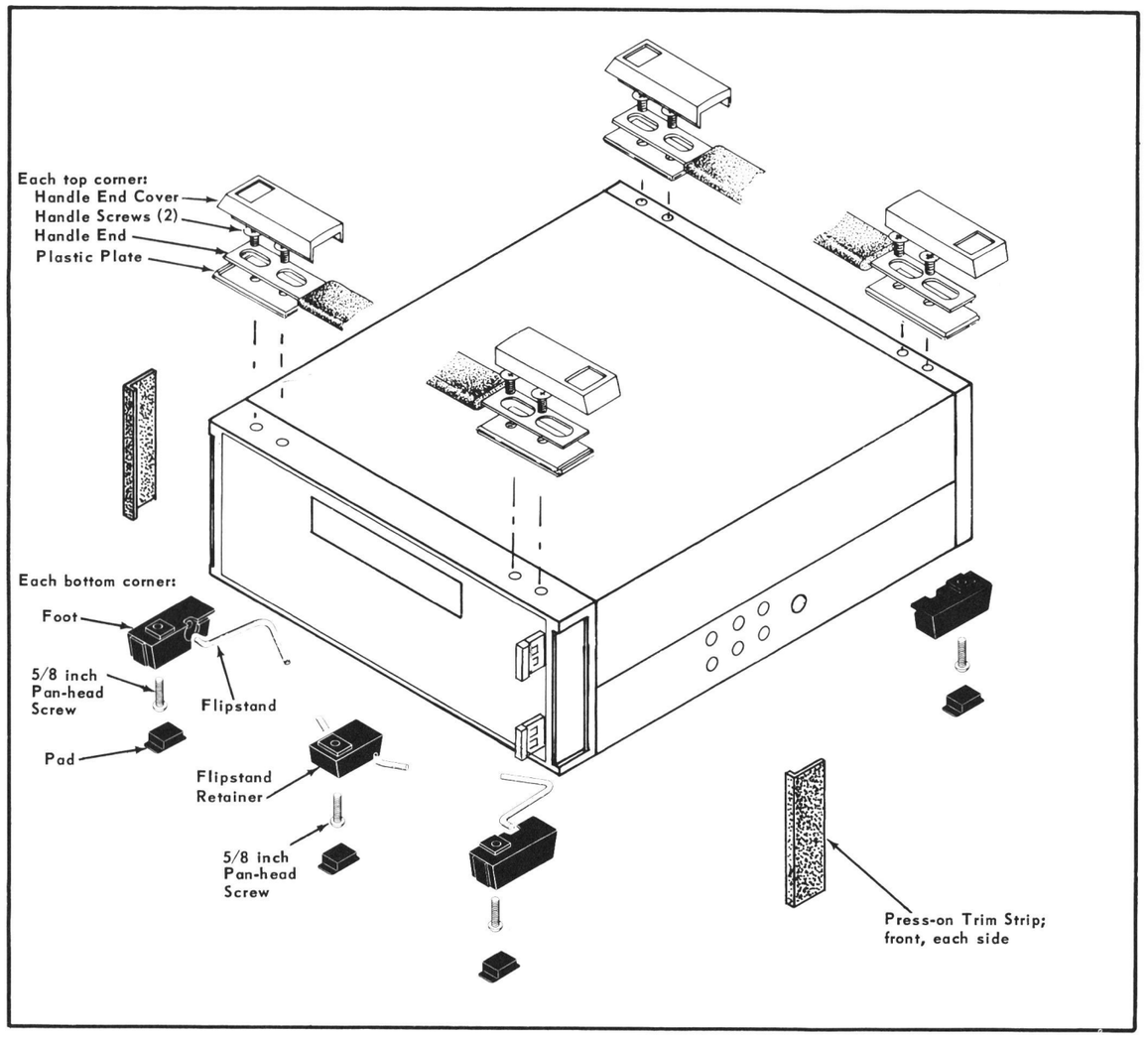


Fig. 8-2. Parts peculiar to the bench-mount instrument (Type 250).

RE-CONVERTING FROM TYPE 250 TO TYPE R250

Removing Parts

Parts peculiar to the bench-mount instrument (Type 250) must be removed from the Auxiliary Program Control Unit chassis before it can be re-converted to a Type R250. These parts are shown in Fig. 8-2 and can be removed as follows:

1. Disconnect the Type 250 from the power source and remove the cables from the rear panel.

2. Place a thin device under the outer edge of one of the plastic end covers and pull up to remove the cover. Remove the two screws from the end of the handle. Repeat this procedure at each of the other three corners of the instrument. The handles and plastic plates can then be removed.

3. Stand the instrument on its rear feet. Remove the front corner trim strips (black) by prying out on their front edges. They are glued in place and removal will probably bend them. They can be bent back into shape for later re-use.

4. Spring the flipstand out of the two front feet. Bend it only as far as necessary for removal, to avoid damaging it.

5. Pry the pads from the feet on the bottom corners of the instrument. Remove the screws from the feet and the screw from the flipstand retainer. Remove the feet and retainer.

Parts Required

The following parts must be added to complete the conversion. Locations of parts to be attached to the chassis are shown in Fig. 8-1. Identification of the slide-out track assembly parts is contained in Fig. 8-4.

TABLE 8-2

Parts Found in the Type R250 Only

Qty.	Item	Tektronix Part No.	Figure Number
1 ea	Modification Kit, Standard-to-Rackmount Conversion; contents as follows:	040-0489-00	
	2 ea Bracket[2], angle, plain	407-0296-01	8-1
	2 ea Handle	367-0076-00	8-1
	4 ea Washer, cup, #10	210-0833-00	8-1
	4 ea Screw, #10-32 X 1/2 OHS	212-512-00	8-1
	4 ea Screw, #10-32 X 7/8 FHS	212-0562-00	8-1
	4 ea Screw, #10-32 X 0.434 FHS	212-0574-00	8-1
	1 pr Track, slide-out section, Tiltlock (chassis section)	351-0082-00	8-1
	1 pr Track, slide, stationary and intermediate sections, mounting hardware included	351-0086-00	8-4
12 ea	Screw, 10-32 X 3/8 PHS	212-0507-00	8-1
12 ea	Nut, keps, 10-32 X 3/8	220-0410-00	8-1
4 ea	Washer, plastic, 0.191 inch ID X 5/8 inch OD	210-0917-00	8-1
2 ea	Strip, trim, blue, 16.3 inches X 0.876 inch	124-0188-00	8-1
4 ea	Screw, #10-32 X 3/8 inch, FHS	212-0574-00	8-1
1 ea	Rackmount Kit, Rear Support; Contents as follows:	016-0097-00	8-10
	2 ea Screw, 1/4-20 X 1/2 inch HHS	213-0001-00	8-10
	2 ea Bushing, instrument securing, 1.05 inches long	358-0310-00	8-10
	2 ea Pin, support, 1/2 inch D	214-0502-00	8-10
	2 ea Washer, neoprene, 0.484 inch ID, 0.828 inch OD	210-0984-00	8-10
	2 ea Washer, flat, 0.512 inch ID, 7/8 inch OD	210-0985-00	8-10

[2]A bracket bearing the inscription "R250" is listed separately under Part No. 407-0296-05.

	4 ea Washer, flat, 0.264 inch ID 1 1/8 inch OD	210-0866-00	8-10
	2 ea Bar, support, 5.0 inches long	381-0279-00	8-10
	8 ea Screw, 10-32 X 1 1/2 inches, RHS	212-0553-00	8-10
	2 ea Spacer, block, 1.625 X 1.0 X 0.50 inch	361-0153-00	8-10
	2 ea Bracket, angle, support	407-0073-00	8-10
	2 ea Lockwasher, internal, 1/4 inch ID, 15/32 inch OD	210-0011-00	8-10
	2 ea Screw, 1/4-20 X 0.750 inch, HHS	213-0134-00	8-10
	4 ea Screw, 10-32 X 1 1/4 inches, HHS	212-0520-00	8-10
	4 ea Washer, flat, 0.204 ID X 0.438 inch OD	210-0805-00	8-10

Installing Parts

1. Loosen the four screws on the top dust cover and lift the cover off.

2. Unscrew the front-panel thumb screws and swing open the front panel of the instrument.

3. Remove circuit cards P1 through P4 and P10 through P13.

4. Unscrew the two nuts holding the plastic shield and cable clamp to the bottom of the right side panel (as viewed from the front). Remove the plastic shield.

5. Remove the nut and washers from the pivot screw of the right side chassis section. The right side section can be identified by the tiltlock release knob which will point toward the top of the unit after installation. (See Figs. 8-1 and 8-6.) Hold the assembly together while removing the nut and while installing the assembly on the chassis.

6. Place the assembly against the chassis, inserting the pivot screw into the hole indicated in Fig. 8-1. Replace the flat washer, lock washer and nut on the pivot screw and hand-tighten the nut. Check that the slide, the tiltlock mechanism, and the chassis side are tight against each other. If not, manipulate the components while working the pivot screw until they do fit together tightly. Then again hand-tighten the nut.

7. Fasten the mounting arm to the chassis, using six 10-32 X 3/8 PHS screws and keps nuts (see Fig. 8-1). Tighten the six nuts.

8. Apply light pressure to the top edge of the track section (black) and note the track position with respect to the bottom edge of the cabinet. If it is not parallel to the bottom, keep the pressure applied and rotate the pivot screw with a screwdriver until the screw's cam action causes the track to be parallel with the bottom of the cabinet. Tighten the nut with a wrench without permitting the pivot screw to turn. After tightening, recheck that the track is parallel to the bottom of the cabinet.

9. Replace the plastic shield in the instrument, re-installing the cable clamp under the rear nut.

10. Install the left chassis section assembly, following the procedure described previously. The left side of the instrument, however, has no plastic shield or cable clamp to remove and replace.

11. Replace the circuit cards in the instrument, close and secure the front panel and replace the top cover.

12. Install and tighten a 10-32 X 3/8 FHS screw in each corner on the bottom of the instrument where the feet were removed.

13. Attach a handle to each angle bracket and connect the brackets to the front corners of the instrument. Note that if one of the brackets contains an R250 inscription, it should be attached to the right corner. The oval head screw, cup washer and plastic washer, shown as part of the handle assembly, should be installed after the Type R250 is placed in a rack.

14.[3] Set the Type R250 on its bottom. Peel the tape from the back of a trim strip. Put the strip in place in the recess at the top-front of the unit by inserting the rear edge first and then lowering the strip into place. Apply a firm pressure along the entire strip to complete the bond. Repeat with the second strip at the rear of the unit.

15. Install the top cover on the instrument.

The conversion has been completed and the Auxiliary Program Unit can be installed in a rack, provided that a rack has been equipped as explained later in this section.

[3]For only temporary re-conversion to a Type R250, this step may be omitted.

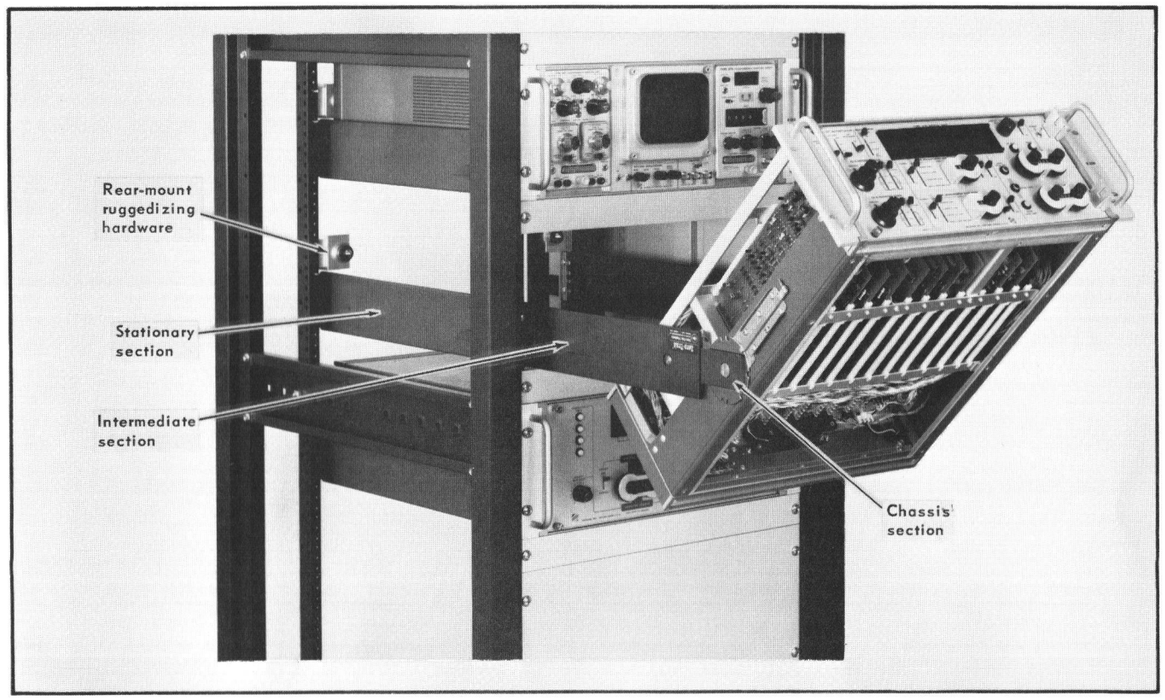


Fig. 8-3. An instrument extended on slide-out tracks; shown with rack sides and instrument panels removed. Mounting of the Type R250 is identical to that of the instrument shown.

RACKMOUNTING THE TYPE R250

General Information

The slide-out tracks permit the Type R250 to be extended out of the rack for troubleshooting or servicing (see Fig. 8-3). When not extended, the instrument is held into the rack with four securing screws.

The chassis sections of the slide-out tracks are installed on the chassis at the factory or can be installed according to the preceding instructions. The stationary sections are to be attached to the mounting rails of the racks. When installed, the intermediate sections slide freely between the chassis and stationary sections as the instrument is pulled out or pushed into the rack.

The mounting hardware provided with the slide-out tracks is intended to make them adaptable to a variety of racks and installation methods. Not all of the hardware will be needed for any particular installation, so only the parts that are required for the specific mounting method should be used.

In order to operate the Type R250 in the extended position, the instrument must be mounted close enough to its companion instruments to permit the interconnecting cables to reach between instruments, and the input power connection must be located close enough for the power cord to reach.

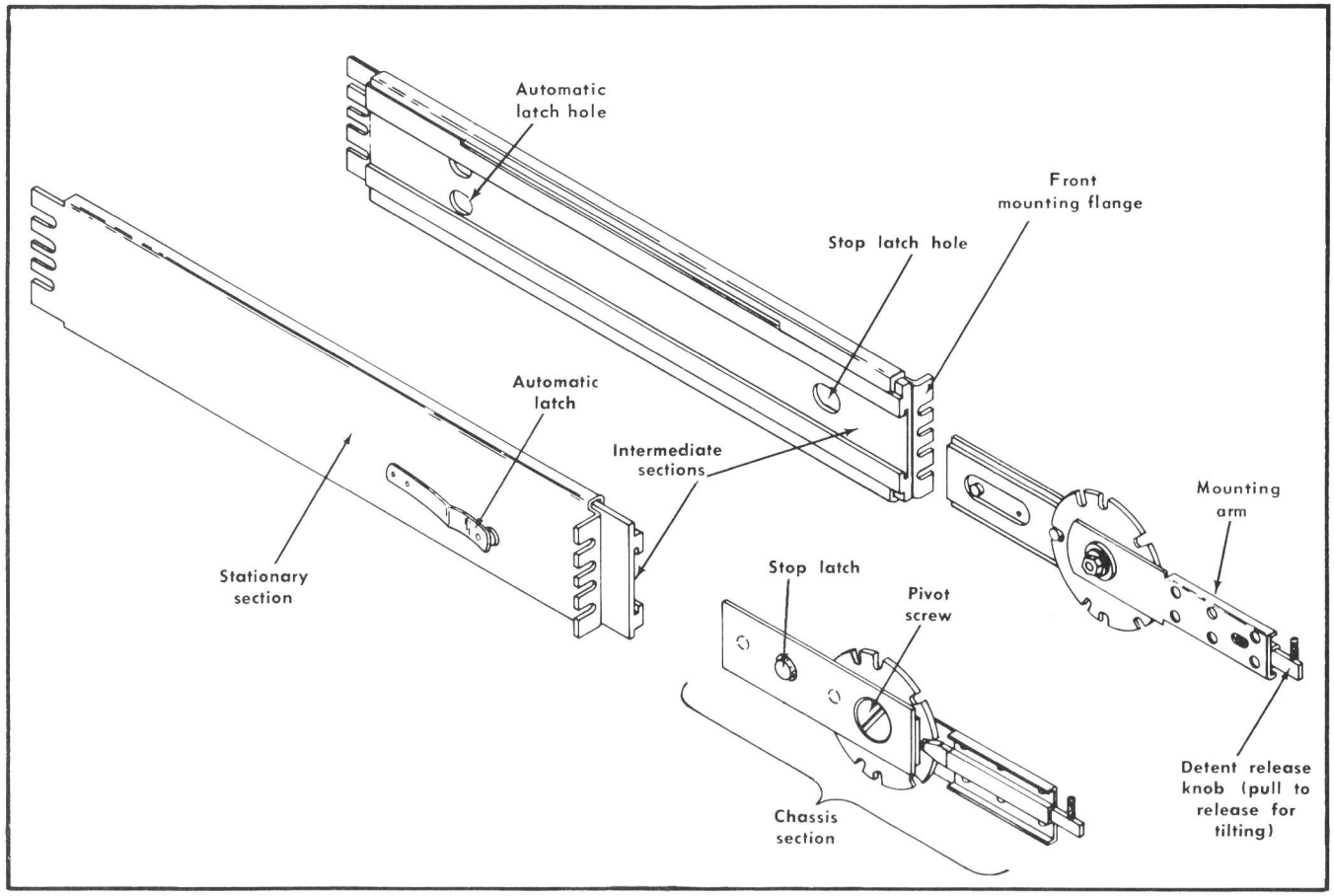


Fig. 8-4. Slide-out track assemblies.

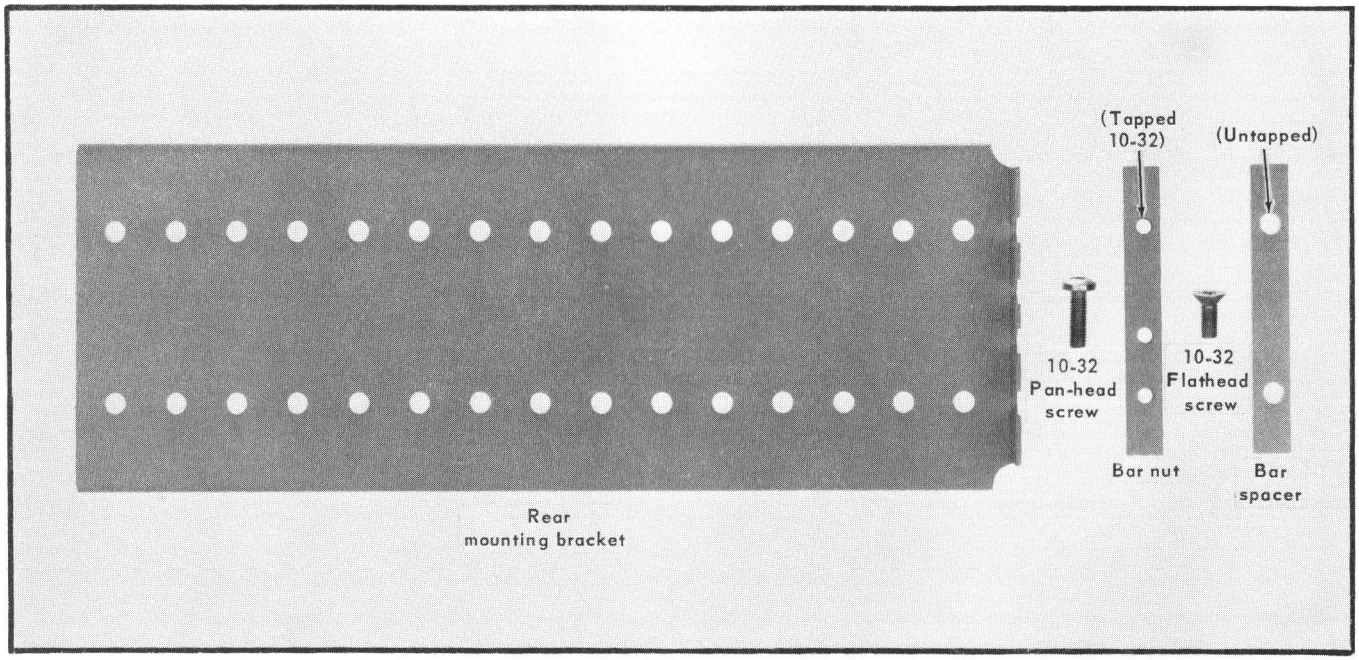


Fig. 8-5. Identification of mounting hardware provided with the stationary/intermediate track sections.

Mounting Considerations

A wide variety of mounting methods is available for installing the slide-out tracks in the rack. The following factors should be taken into consideration when choosing the mounting method for a particular installation:

1. Depth of the rack.

2. Degree of mechanical stability required.

3. Mounting method used for other instruments in the rack.

4. Type of mounting holes in the supporting rails; that is, whether they are tapped, untapped or countersunk.

5. Whether or not the rear support rails are movable, and if movable, whether they can be positioned at any location or moved only in discrete increments.

6. Relative thicknesses of the front panels of the various instruments in the rack.

7. General appearance desired for the completed rack assembly.

These factors will usually determine whether the front mounting flanges of the stationary sections are to be mounted in front of the front rails or behind them, whether or not the ruggedizing rear-support hardware is to be used, etc.

Front-End Mounting with Tapped Front Rails. If the mounting holes in the front rails of the rack are tapped for 10-32 screws, the easiest method of attaching the front ends of the stationary sections to the rack is to mount the front flanges in front of the front rails (see Fig. 8-8A and B). When mounted in this position, 10-32 pan-head screws may be used directly to attach the front flanges to the rails, or 10-32 flathead screws may be used with countersunk shim material to clamp the front flanges to the rails.

The use of countersunk shim material provides better support for the front flanges and also permits depth adjustment of the front panel. If the various instruments in the rack have different panel thicknesses, different thicknesses of shim material can be used to make the front surfaces of all panels flush with each other. The shim material should be approximately 1/2-inch wide and have a minimum thickness of approximately 1/8 inch to accommodate the countersunk screw heads. Each strip should be at least as long (vertical dimension in the rack) as the width of the front flanges of the stationary sections (3 1/8 inches). Since the dimensions of the shim material are determined entirely by the dimensions of the rack installation, no shim material is provided with the mounting hardware.

NOTE

When the flanges are mounted in front of the front rails or when shim material exceeding 1/8-inch in thickness is used, special adjustment of the ruggedizing rear-mount hardware may be required (see Standard Rear-End Mounting below).

Front-End Mounting with Untapped Front Rails. If the mounting holes in the front rails are not tapped, bar nuts (Fig. 8-5) must be used behind the rails to accommodate the mounting screws. All of the options previously described for tapped front rails also apply to the untapped rails when used with bar nuts. In addition, the untapped front rails (with bar nuts) permit the front mounting flanges to be attached to the rear sides of the front rails if desired (see Fig. 8-8C). When mounted in this position, the flanges are clamped between the bar nuts and the front rails. Either 10-32 pan-head screws or 10-32 flat-head screws with shim material may be used as described for tapped front rails, or 10-32 flat-head mounting screws may be countersunk into the front rails.

Standard Rear-End Mounting. To provide an adequate shock-mounted installation, the rear end of each stationary section must be mounted firmly to a rear-support rail using the ruggedizing hardware. If the rack does not have a strong supporting member located the correct distance from the front rails (Fig. 8-6), an additional support must be provided. Use the 10-32 round-head screws provided in the ruggedizing kit (see Fig. 8-10) to mount the rear bar supports to the rear rails, and use 10-32 pan-head screws to attach the stationary sections of the tracks to the bar supports. If the mounting holes in the rear rails are not tapped, bar nuts must also be used for mounting the bar supports.

NOTE

Additional washers and possibly longer support-pin and/or securing bushing screws (Fig. 8-10) may be needed to make the ruggedizing support fit securely if any of the following conditions exist:

1. *If the front flanges of the stationary sections are mounted in front of the front rails.*
2. *If more than 1/8-inch of shim thickness is used for mounting the front flanges.*
3. *If the support rails are located at fixed positions such that the distance from the front surface of the front rail to the rear surface of the rear rail is slightly greater than 21 inches.*

No more than about 1/2 inch of washer thickness can be added to each rear-support mounting without deteriorating the ruggedizing capabilities of the installation.

Non-Ruggedized Rear-End Mounting. If the rear support rails cannot be positioned so that the distance from the front surface of the front rails to the rear surface of the rear rails is approximately 21 inches, the rear-mount ruggedizing hardware cannot be used. Or if the particular installation does not require a high degree of physical rigidity, the use of ruggedizing hardware may be omitted. In either of these cases, an alternative method of supporting the rear ends of the stationary sections is required. Fig. 8-12 illustrates two alternative mounting methods using the rear-mounting brackets instead of the ruggedizing hardware. The depth between the front and rear rails of the rack will determine which of these configurations should be used.

CAUTION

Although the alternative mounting methods shown in Fig. 8-12 provide adequate support under normal operating conditions, they do not provide the solid rear-mount support required for a ruggedized installation. If mounted without the ruggedizing hardware, the instrument may be damaged if subjected to severe vibration or shock.

Rack Dimensions

Fig. 8-6 shows the maximum and minimum dimensions required between support rails to provide adequate support for the Type R250 and to assure proper operation of the slide-out tracks. Minimum overall depth of the rack from the front surface of the front rails to the rear of the cabinet must be at least 22 1/2 inches to accommodate the rear-mount ruggedizing hardware, power cord and interconnecting cables, and to provide enough space for air circulation.

Mounting Procedure

The following mounting and alignment procedures use the rear-support ruggedizing hardware for attaching the rear end of each stationary section to the rear support rail. If the ruggedizing hardware is not to be utilized, refer to the procedure exceptions given under Non-Ruggedized Mounting which follows the Alignment Procedure.

The stationary and intermediate sections of the slide-out tracks are shipped as matched pairs and should not be separated. To distinguish between the right and left stationary/intermediate assemblies, note the position of the automatic latch (see Fig. 8-4) in each assembly. The automatic latch should be located near the bottom of the assembly when it is installed in the rack.

Use the following procedure to install the stationary sections of the slide-out tracks and the Type R250 in the rack:

1. Referring to Fig. 8-7, select the proper front-rail mounting holes for the stationary sections.

2a. If the front flanges of the stationary sections are to be mounted in front of the front rails, mount the front of each stationary section as shown in Fig. 8-8A or B.

2b. If the front flanges are to be mounted behind the front rails, mount the front end of each stationary section as shown in Fig. 8-8C.

3. Temporarily attach a bar support to the rear end of each stationary section with two 10-32 pan-head screws and a bar spacer. Do not tighten the screws.

4. With the front end of each stationary section attached to the front rail, hold the track in a level position in the rack and locate the proper rear-rail mounting holes. (See Fig. 8-9).

5. Attach the bar supports to the rear support rails with 10-32 round-head screws (Fig. 8-10), using at least two mounting screws for each bar support.

6. Tighten the screws holding the bar supports to the rear rails, then tighten the screws holding the stationary sections to the bar supports.

7. Mount the angle brackets and spacer blocks on the bar supports as shown in Fig. 8-10, but do not tighten the screws.

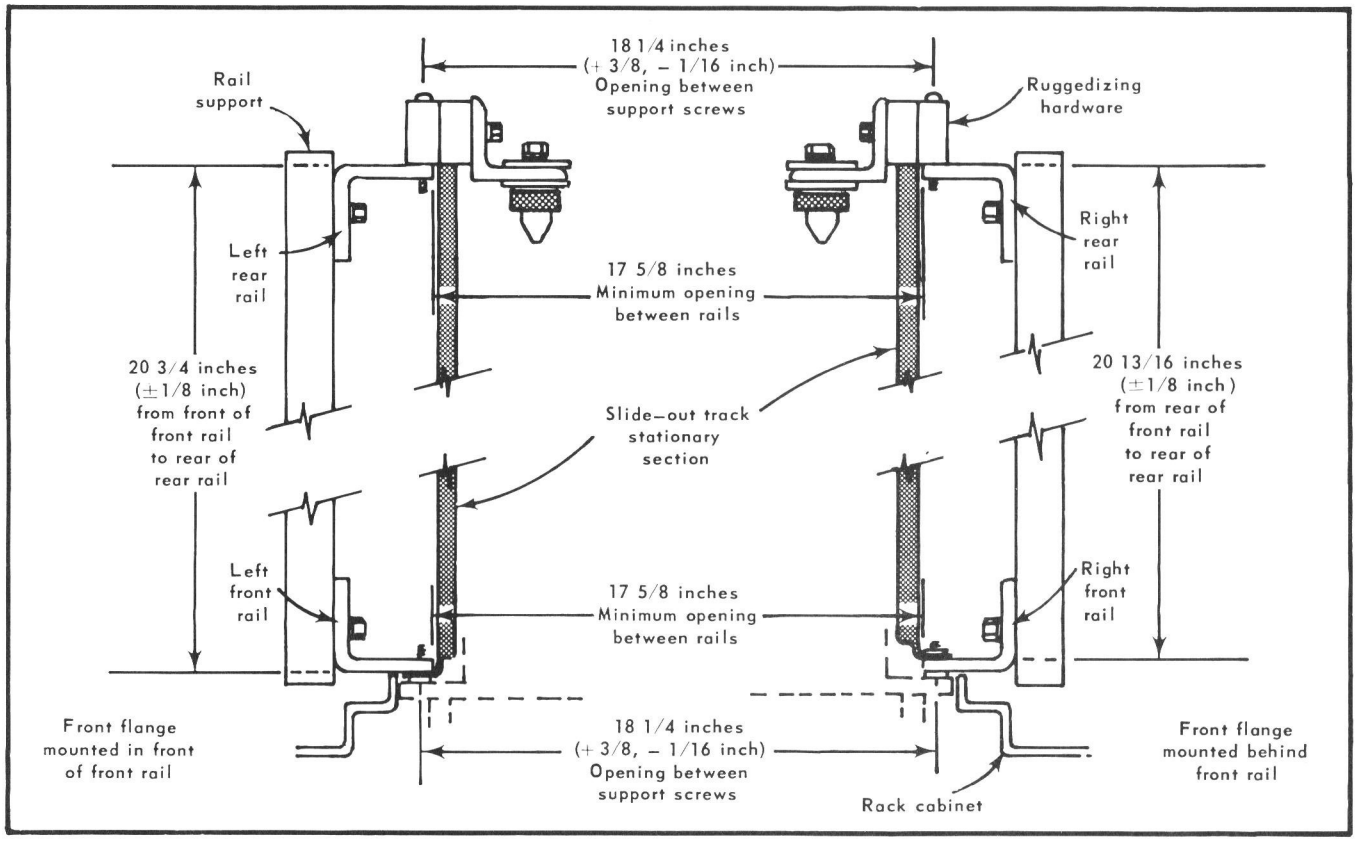


Fig. 8-6. Required spacing of support rails for mounting stationary sections of slide-out tracks.

8. Fasten the support pins and washers to the angle brackets in the order shown in Fig. 8-10, but do not tighten the screws. Be sure the spacers are properly centered.

9. Remove the top dust cover from the Type R250 and mount the two securing bushings (Fig. 8-10) on the rear panel of the instrument with 1/4-20 hexagonal-head screws. Tighten the screws and replace the dust cover on the instrument.

10. Referring to Fig. 8-13, insert the instrument into the rack. Do not connect the power cord or interconnecting cables yet and do not install the securing screws.

Alignment Procedure

Use the following procedure to adjust the instrument alignment in the rack:

1. Position the instrument approximately half way out of the rack so that the point of rotation on each chassis section is adjacent to the front rail of the rack.

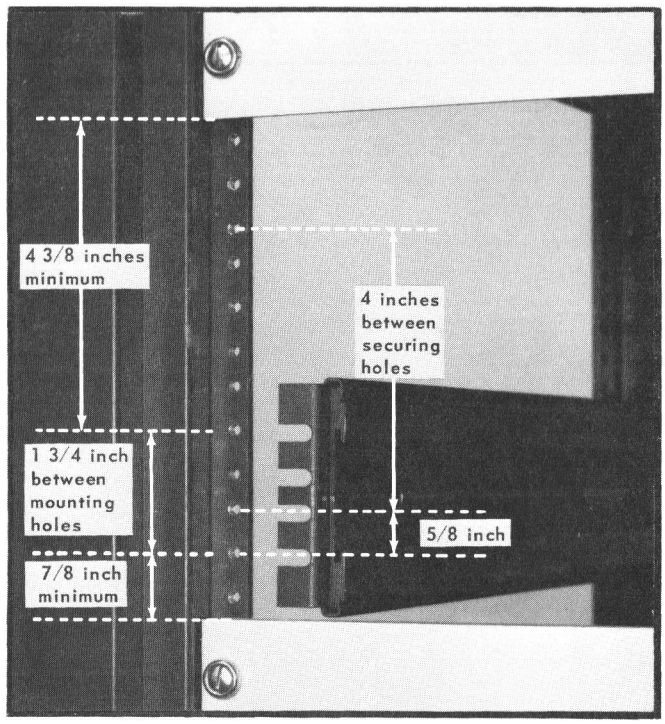


Fig. 8-7. Vertical mounting position for front end of slide-out tracks.

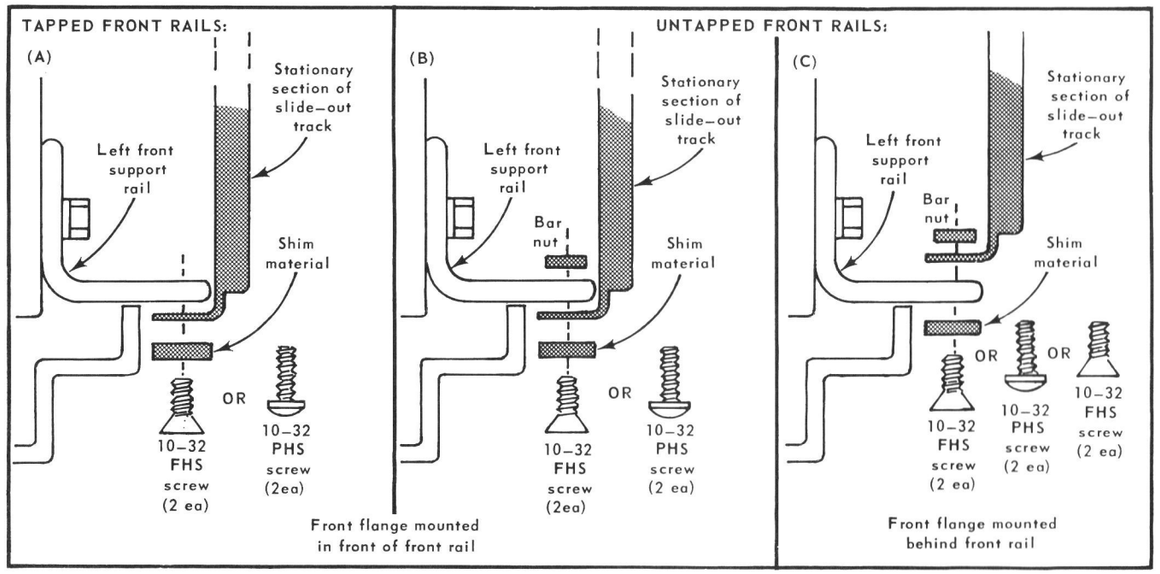


Fig. 8-8. Methods for mounting front end of stationary sections as described in the text. Thickness of optional shim material is selected to compensate for differences in front-panel thickness of various instruments in rack. (Shim material described in the text is not provided.)

2. Loosen the mounting screws holding the front mounting flanges to the front rails.

3. Hold the instrument in the center of its mounting space and re-tighten the front mounting screws.

4. Push the instrument all the way into the rack and check the vertical and horizontal alignment of the front panel of the instrument. If necessary, readjust the positioning as described in steps 2 and 3.

5. Push the instrument all the way into the rack again and install one securing screw through each handle bracket, using a finishing washer and a plastic washer with each securing screw as shown in Fig. 8-13. If the front rails are not tapped for the 10-32 securing screws, some other means of securing the instrument into the rack must be provided.

NOTE

If the instrument does not slide all the way into the rack easily, check the fit of the rear-support ruggedizing hardware before installing the securing screws. If necessary, move the inside support-pin washers to the outside of the angle brackets (Fig. 8-10).

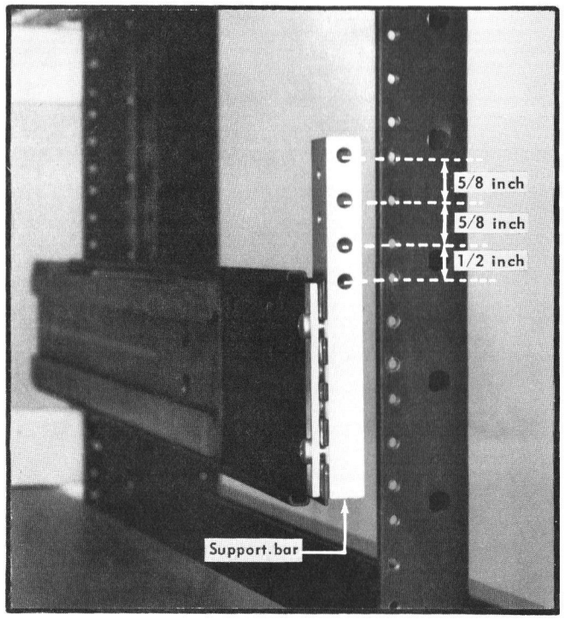


Fig. 8-9. Vertical mounting position for rear end of slide-out tracks. Left stationary section is shown.

6. Press each securing bushing over the support pin and check alignment of the ruggedizing hardware.

7a. If the securing bushings and support pins fit tightly together with the neoprene washers seated against the securing bushings, hold each angle bracket firmly in place and tighten the angle-bracket screws and the support-pin screw. Fig. 8-11 shows the completed installation of the left rear support.

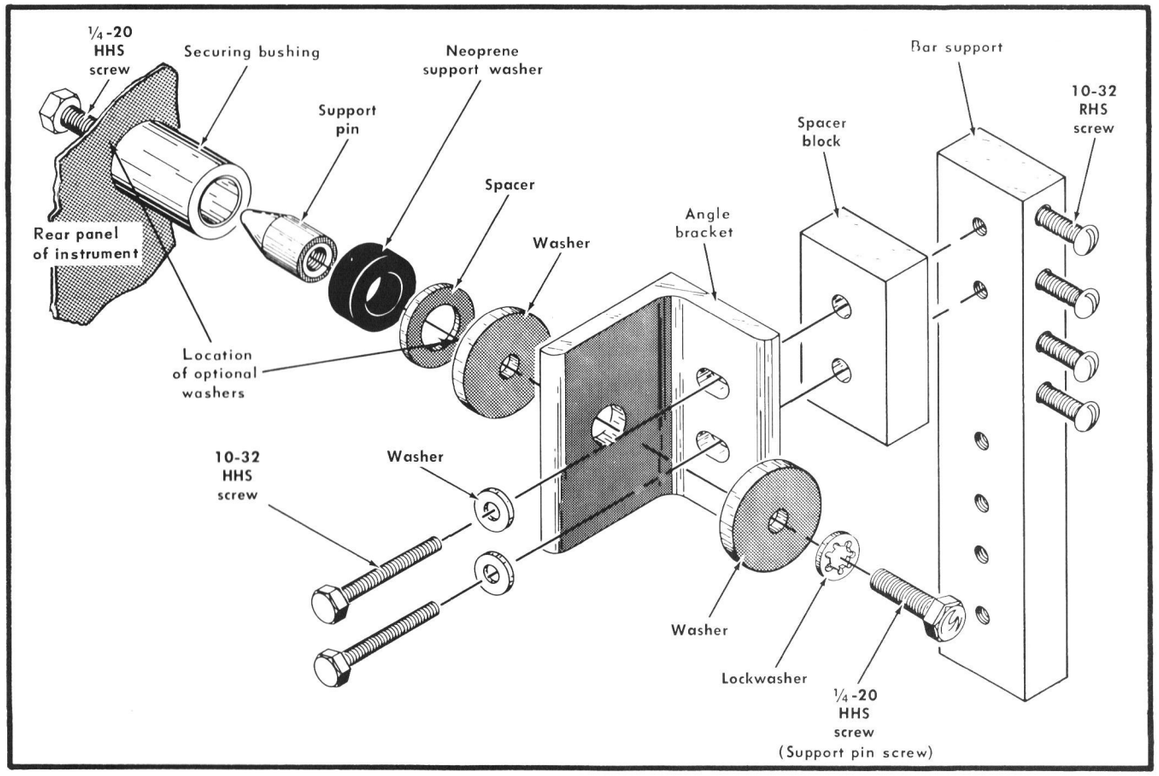


Fig. 8-10. Rear-support ruggedizing hardware. Optional washers (purchased separately under Tektronix Part No. 210-0866-00) may be required for depth adjustment as described in the text.

7b. If the securing bushing and support pin do not fit tightly together, determine what adjustment is necessary; i.e., whether one or more additional washers are required for a tight fit, etc. Remove the securing screws, extend the instrument part way out of the rack and make the necessary changes in the ruggedizing hardware, then repeat steps 5, 6 and 7a.

8. Secure the handle brackets of the Type R250 to the front rails of the rack with the four securing screws (Fig. 8-13).

NOTE

The securing screws are an important part of the shock-mounted installation.

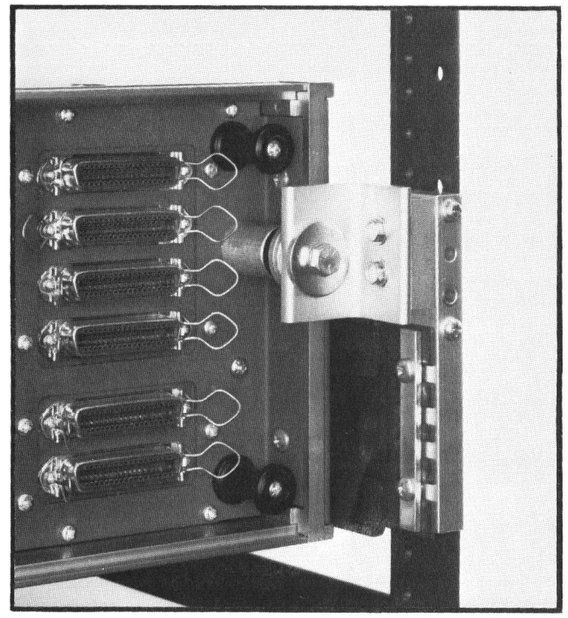


Fig. 8-11. Completed installation of left rear support.

9. After all adjustments have been made and all hardware has been tightened securely, connect the power cord to a suitable power source and connect the program cables to the proper connectors on the rear panel of the instrument.

Non-Ruggedized Mounting Procedure

If the ruggedizing hardware is not to be used, refer to Fig. 8-12 for mounting the rear end of each stationary section and modify the standard Mounting and Alignment procedures as follows:

Mounting Procedure

Perform steps 1 through 2b.

Omit step 3.

Perform step 4.

Perform new step 5: Attach the rear mounting brackets to the rear support rails as shown in Fig. 8-12 and tighten the screws securely.

Omit steps 6 through 9.

Perform step 10.

Alignment Procedure

Perform steps 1 through 5. (Omit the Note in step 5)

Perform new step 6: Loosen the screws that hold the rear mounting brackets to the support rails and allow the rear ends of the stationary sections to seek their normal positions. Tighten the rear mounting bracket screws while holding up on the rear of the instrument so that the weight is removed from the brackets.

Omit steps 7a and 7b.

Perform steps 8 and 9.

Slide-Out Track Lubrication

The special finish on the sliding surfaces of the slide-out tracks provides permanent lubrication. However, if the tracks do not slide smoothly even after being properly adjusted, a thin coating of paraffin may be rubbed onto the sliding surfaces for additional lubrication. It will be necessary to remove the tracks from the rack to do this.

Removal and Re-insertion

After the initial installation and adjustment of the slide-out tracks, the Type R250 may be removed or re-inserted in the rack by following the instructions given in Fig. 8-13. Under normal circumstances, no further adjustments are required.

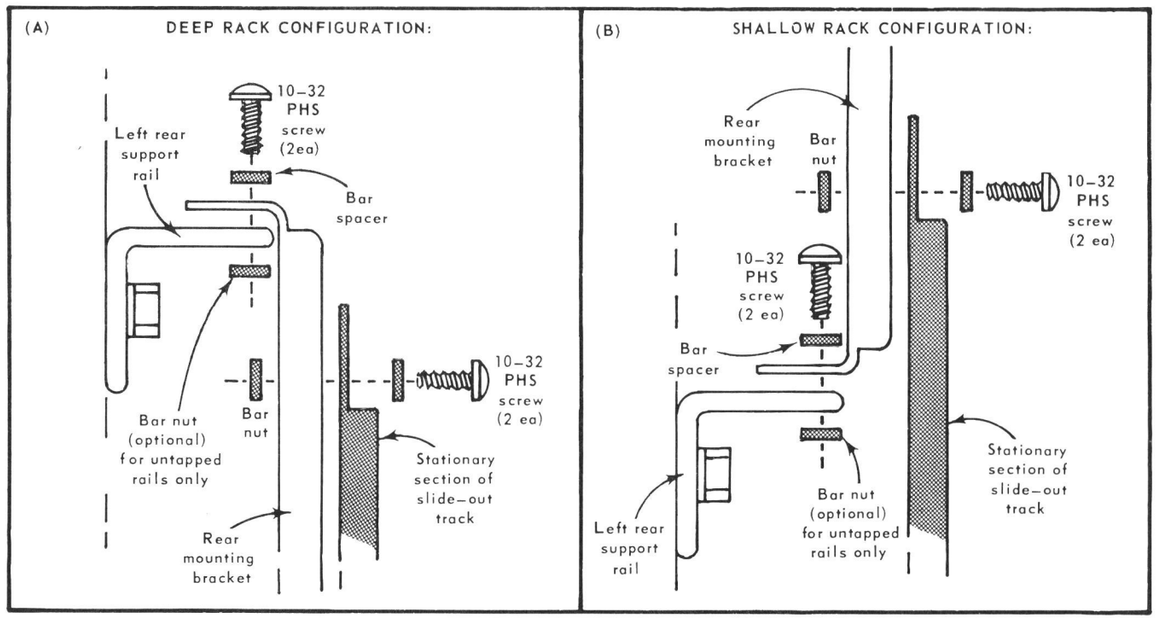


Fig. 8-12. Non-ruggedized mounting: (A) For use with racks deeper than 21 inches from the front of the front rail to the rear of the rear rail; (B) For use with racks shallower than 21 inches.

TO INSERT THE INSTRUMENT:

1. Pull out the intermediate section (A) of each slide-out track to its fully extended position.

2. Insert the chassis sections (B) into the intermediate sections and push the instrument in until the stop latches (C) hit the intermediate sections.

3. Press both stop latches (C) and push the instrument in until the stop latches snap into the stop latch holes (D).

4. Press both stop latches (D) and push the instrument all the way into the rack. The automatic latches will release as the instrument is pushed in.

5. Insert the 4 securing screws (E) (with finishing washers and plastic washers) through the slots in the handle brackets and screw them into the front rails of the rack.

TO REMOVE THE INSTRUMENT:

1. Disconnect the power cord and remove the interconnecting cables from the rear-panel connectors.

2. Remove the securing screws and washers (E).

3. Pull the instrument outward until the stop latches snap into the stop latch holes and the automatic latches snap into the automatic latch holes.

4. Press both stop latches (D) and pull the instrument out of the rack.

5. Press the automatic latch in each intermediate section and push the track into the rack.

6. Connect the proper interconnecting cables to the rear-panel program connectors and connect the power cord to a suitable power source.

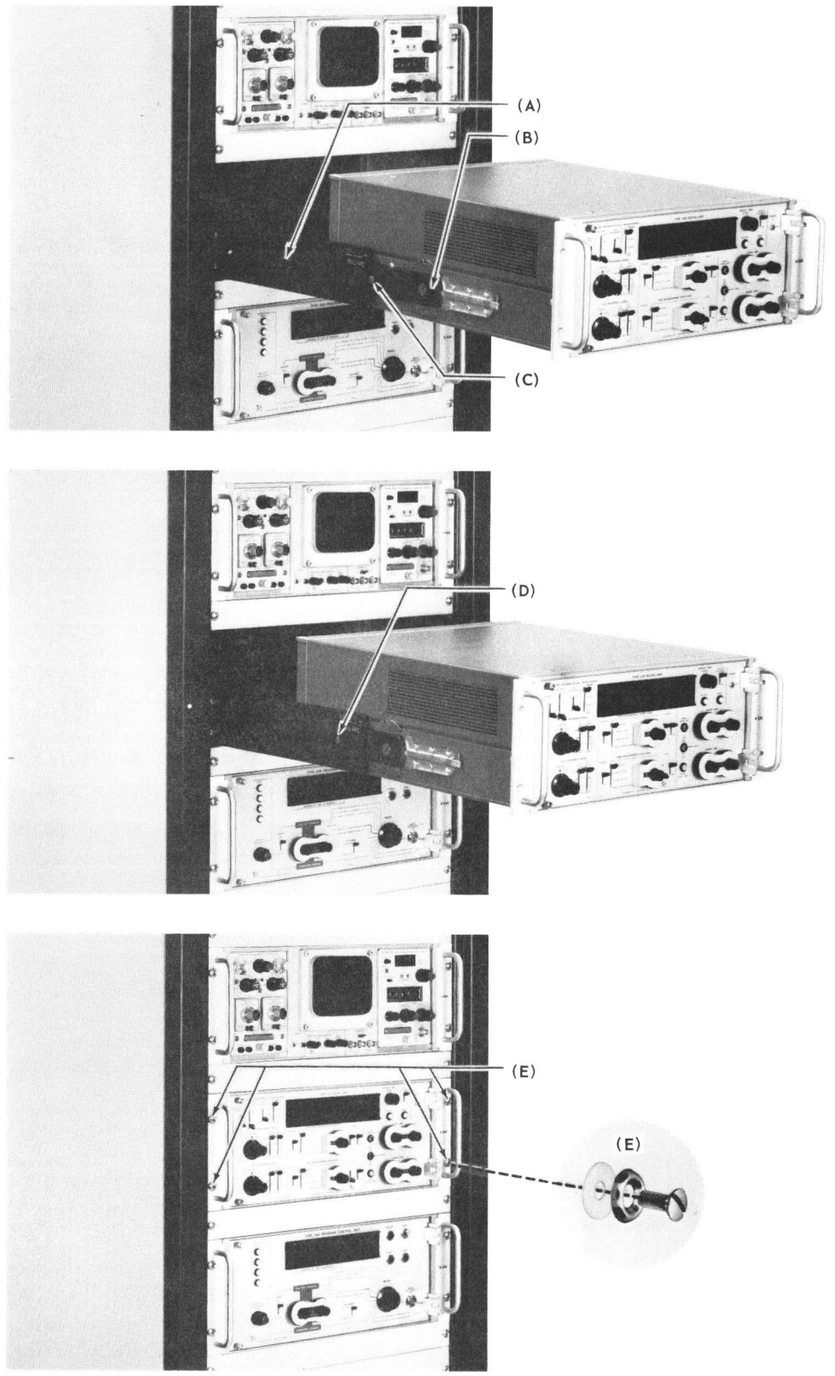


Fig. 8-13. Insertion and removal of a rackmount instrument after the slide-out tracks have been installed.

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TYPE 250/R250 TENT SN B020120

TEXT CORRECTIONS

Section 2 Circuit Description

Page 2-6 +180 V Unregulated Supply

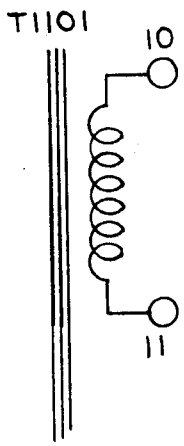
REMOVE: all text and the heading referring to +180 V Unregulated Supply.

ELECTRICAL PARTS LIST CORRECTION

REMOVE:

C1105	290-0213-00	10 μF	EMT	450 V	
D1104	152-0107-00	Silicon		6107	
R1104	315-0101-00	100 Ω	1/4 W		5%
R1105	301-0304-00	300 kΩ	1/2 W		5%
R1106	308-0206-00	7.5 kΩ	5 W	WW	

SCHEMATIC CORRECTION



PARTIAL

POWER SUPPLY AND TERMINAL STRIPS

◇2◇

M14,661/1268

TYPE 250/R250

ELECTRICAL PARTS LIST CORRECTION

P13 Circuit Card Assembly

REMOVE:

D1266	152-0333-00	Silicon	High Speed and Conductance			Model 2 - up
D1276	152-0333-00	Silicon	High Speed and Conductance			Model 2 - up

ADD:

R1265	315-0102-00	1 kΩ	1/4 W	5%	Model 2 - up
R1275	315-0102-00	1 kΩ	1/4 W	5%	Model 2 - up